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Prevention of Sulphating in Accumulators. MOST of the alleged improvements in accumulators deal with the shape and form of grids to prevent the active material from falling out. But in experiments made in England by Mr. D. Fitz Gerald, who has done very creditable work in the accumulator field, he attacks the problem in a different way, and, if reports are correct, he has been more successful than those who try, by changing the shape of the holes in the grids, to keep the material in them. He goes back a little farther and tries to prevent the formation of the layers of sulphate between the active material and the lead surface to which it is held; for it is this layer of sulphate, forming, as is well known, on the discharge, which is at the root of much of the evil. His experiments seem to show that by gilding the lead plates of the grids even only quite lightly, the formation of this sulphate is prevented. If such gilding does not develop new and unforeseen difficulties, as most new inventions in accumulators do, it may prove to be one of the most important in the recent development of this much abused apparatus, the lead accumulator.

Dynamo Designing. IN another column Mr. Picou, an engineer of one of the largest electric companies in France, gives some points regarding dynamo design which are well worth the attention of those engaged in this class of work. He points out more particularly the importance of designing a dynamo with respect to the nature of the work to be performed by it, showing, by examples, that rules in designing may be good in one case and bad in another, or, in other words, that fixed stereotyped rules cannot be laid down, but that one must be guided by the particular purpose for which the dynamo is intended. For instance, armature reaction, which ought to be avoided as much as possible in constant potential machines, is exactly that which is needed in constant current machines. Though not new to many engineers, these principles are clearly explained in this article in a way in which they cannot fail to be of use to the large majority of dynamo builders. The numberless amateurs in this field who write to professional men asking them to "please send me by return mail the rule for building a dynamo for 20 lamps, I inclose a two-cent stamp," will do well to read this article, from which they will see how many points there are to be considered, and how impossible it is to give any fixed rules for dynamo designing.

Trolley Accidents. MANY of our daily papers still continue to publish items under this heading, tending to make the public believe that the electricity used on electric railways is some terrible monster killing innocent victims daily all over the country. Long haired, long eared wiseacres doubtless conclude from this that the queer thing called electricity is the mischief maker and is to blame for it all, and that it should, therefore, not be allowed in any city. Some of the daily papers even go on ranting about this in the most absurd style, showing their total ignorance of the truth and their inability to express unbiased opinions. A person who is really in search of the truth will find that almost all such accidents are of the nature of run-overs, collisions and the like, which are due solely and entirely to the fact that a tramcar is running through the public streets, accidents such as may and do occur with all other means of traction, be it by cable, steam, horses, or any other power. The mere fact that electricity is used for propulsion has nothing whatever to do with such cases. The public demands rapid transit in cities, and it must be furnished with it in some way. Now any means of rapid transit on surface roads in crowded cities is naturally accompanied by some risk of life due to possible run-overs and collisions, but this is due to the public's cry for rapid transit and not to the fact that electricity is used, as any unbiased mind will readily see. If electricity enables the public to have cheap rapid transit the people ought to be glad and ought not to blame electricity for accidents due to rapid transit *per se*, apart from the method of propulsion.

Cheap Engineers and Expensive Lawyers. WE frequently receive very decided expressions of opinion from those whose experience makes them the best judges against the old-fashioned, short sighted, penny-wise and pound-foolish policy of employing the cheapest possible service in engaging professional engineers, while, when it comes to lawyers' fees and presidents' and managers' salaries, large sums are paid without hesitation. Any one who will take the trouble to find out how much time must be spent and what the amount and the nature of the studies are, to become a good engineer, and then compare this with that required to become a good lawyer, cannot fail to notice how much greater the former is. Moreover, in the engineering profession one must continue to study and keep abreast with the rapid progress made in engineering, while in the lawyer's profession the term "progress" hardly exists. Of the four professions, medical, theological, law and engineering, the latter is certainly the one in which one's reputation depends entirely on ability, that is, the one which requires the most conscientious work in order to gain and keep a good reputation. When an engineer is ignorant, and makes mistakes in building a bridge, machine, or a mining plant, for instance, which thereby breaks down, there is no question where the fault lies and whose it was, and, what is worse, the lives of innocent victims are often at stake. Of all professional men, therefore, the engineer must work, study and practice in the most thorough and conscientious manner. He should, therefore, be selected with the greatest possible care, and receive the most liberal remuneration. The man who will take the greatest care in engaging a physician, regardless of cost, will go to his factory and engage cheap and incompetent professional engineers, and practically entrust the success of his manufactured products or constructions to their care, and then wonder why other manufacturers who pay for able talent are more successful. Some companies pride themselves and with right, on the professional engineering talent which they employ and can retain by paying properly for it, but there still appears to be many who stick to the short-sighted policy of underpaying the one in whom the success of their products to a great extent lies.

Electricity in Chemical Industries. MOST of the numerous and various applications of electricity are of such a nature that engineers and the reading public soon become familiar with them, but this is not always the case with new developments in electro-chemistry, as chemical processes, when not secret, are, as a rule, of less interest and of little importance to the public, except in so far as they result in the cheapening of a product. Many people, therefore, do not know the great and important progress which is being made in this field. The great cheapening in the price of pure aluminium and of the aluminium alloys, for instance, is largely due to electric processes. Electric bleaching is much more common than is generally supposed. Electric processes for extracting metals from ores are becoming of more importance every day, although comparatively little appears about it in current electrical literature. A cable dispatch just received from England announces the discovery of a new electric process for obtaining caustic soda, chlorine, and other commercial chemicals from salt water. It is stated to have been pronounced a great success by prominent chemists and to cost but half as much as the present methods. The dispatch gives no other details, and until it is verified and accompanied by further details little need be said about it here. That such processes are possible, however, is well known to all educated electricians, as they may be performed in any laboratory; it remained only to bridge the gap, which often is very wide, between the laboratory experiment and a cheap and practical chemical process. If these difficulties have been overcome, as the dispatch leads one to believe, and if such a saving is really effected, the result will doubtless be not only of importance to the manufacturing chemist, but also to other industries in which such important chemicals as caustic soda and chlorine are used. The oceans are practically inexhaustible mines of these products, which are and always will be free to the public; this "raw material" can never be taxed by any artificial protective tariff, and monopolies and trusts for raising the prices of this raw material are forever beyond the control of politicians and legislation. A better source of supply could not be desired. It remains only for ingenuity and enterprise to develop processes for converting this free raw material nto commercial products, which, if this report from England is reliable, appears to have been accomplished.

Litigation Regarding Electric Railway Patents. IT appears from a circular recently issued by the General Electric Company that it is on the warpath in earnest in endeavoring to obtain control of the electric railway field. Owning as it does the inventions of Edison, Thomson, Van Depoele and Sprague, who are recognized as the creators of the modern electric railway, it certainly appears to stand some chance of covering the field quite effectually. The circular gives the list of lawsuits which the company has instituted against electric railways in different parts of the country on whose roads some devices are used for which the General Electric Company claims to have the patents. Among the subjects of the pending suits are the following: the under-running trolley, covered by four patents of Van Depoele, dating from 1889 to 1892, the latter especially being claimed to be a "broad patent for under-running, upward-pressing contact trolley;" electric motor trucks, covered by three patents of Sprague, the earliest dated 1885, covering motors which are sleeved on the axle and supported by springs at the other end, also for individual motors for separate axles; duplicate controller switches at opposite ends of the car, reversing motor and regulating resistance of motor circuit, a recent patent of Sprague; trolley having constant pressure with pole at varying angles, an early patent of Van Depoele; arched suspenders for electric railway trolley wires, three patents of Van Depoele; lightning arrester, Thomson's patent, 1885; constant potential regulation by a compound dynamo, Edison's patent, 1882; overhead switches and arched suspender and pull-off for trolley wires, five patents of Van Depoele. The circular concludes with the statement that the company believes that all the apparatus and devices employed in the modern electric railway are broadly covered by these patents, and that the courts will so determine them. There is little doubt that if the courts do decide all these cases in its favor the General Electric Company will have a practical monopoly of the electric railway interests for some years to come, as there appears to be little left for any one to use in the construction of an electric railway which would not come under one or the other of these patents. For the present we will reserve our opinion as to the probable outcome of these suits. That the fight will be a bitter one is not at all unlikely, and perhaps, as in some other cases, it will last about as long as the remaining life of some of these patents.

Designing Dynamo-Electric Machinery.

BY R. V. PICOU.

"Which is the best dynamo?" "Which is the best transformer?" are questions which every electrical engineer has been asked. They are easy to ask but difficult to answer. In the early days of the electrical industry, when electric lighting was confined chiefly to the use of arc light machines, and when very few types of dynamos were on the market, one might try to give a definite answer; but at the present time, after so large a number and so many different applications have been made, the only safe reply seems to be, "the best machinery is that which fulfills in the most satisfactory manner the various requirements of the particular application for which it is intended," a reply which is by no means satisfactory to the inquirer.

During the past ten years electrical engineers have learned how to build dynamos which will give the required volts and ampères at a definite speed; but this is not sufficient at the present day. Every kind of work being done by a dynamo requires a machine having special properties, and it should be the aim to secure these properties in order that the dynamo may give the most satisfactory results in actual practice. Electrical engineers are obliged, more and more, to design their machines to suit some particular requirements, or to do some particular kind of work; for this reason the field which is opened to their ingenuity is certainly more extended than that for the designers of steam engines, for instance.

In dynamos the specific properties of any type of machine may depend, to a great extent, on the shape of its characteristics curves. A few words on the properties of such curves will not be inappropriate,

Regarding these curves a suggestion was recently made in America by M. Brodie, I believe. He calls attention to the fact that the appearance of these curves was varied very much by simply changing the scale of the ordinates or abscissas. For the sake of facilitating a comparison of curves drawn from different dynamos, he propcsed that an agreement should be laid on a uniform scale by taking, for instance, one centimetre to represent 10 ampères or 10 volts, and so on. I do not think that the desired end can be reached by this method, and I venture to suggest that there are other means by which it is more likely that the desired uniformity could be obtained. I would suggest the use of the following: as abscissas, the value of **H**, that is, the magnetizing force, or, practically, the ampère turns per centimetre of length of the magnetic circuit; as ordinates, the value of **B**, that is, the mean induction as calculated from the measured volts and the dimensions of the iron core in the armature; and, furthermore, always to retain the same ratio between the unit lengths representing, say, 1,000 induction lines and 10 ampère-turns per centimetre. By doing this, whatever may be the size of the machine, or its shape, its output or voltage, the characteristic curve will always be directly comparable with any other curve obtained from any other dynamo.

In the "open circuit curve" of a shunt dynamo there is no difficulty; in the "closed circuit curves" the measured volts must be corrected by deducting or adding (according to whether it is for a dynamo or motor) the loss due to the internal resistance of the main winding, a quantity which may easily be calculated. No other correction is needed, and the difference between the "open circuit" and "closed circuit" curves will then show the demagnetizing effect of the armature current.

For a compound dynamo, the most complicated case, the abscissas should furthermore be divided into ampères of the main current and ampères of the shunt current, and the ordinates should be divided into volts. Then draw two straight lines showing the volts (that is, the products of the currents and resistances) lost in the main series winding (including the armature) and in the shunt winding of the dynamo. Such curves will give a plain picture of the dynamo and the study of these curves will enable one to make a complete analysis of the machine. Such curves are of the same importance and value as the indicator diagrams of a steam engine, although their meaning is, of course, quite different.

Returning now to the design of a dynamo, let us take as an example the case of two machines, both for a mean load of, say, 100 volts and 100 ampères, the one intended for incandescent lighting and the other for charging a secondary battery. Will the same dynamo give a satisfactory result in either of these cases? Certainly not; two different machines are needed having very different characteristic curves. An incandescent lighting plant requires a steady voltage and the least possible attendance; these requirements are of prime importance in designing the dynamo.

Referring to Fig. 1, let *A B C* be the characteristic open circuit curve of a shunt dynamo. It will be noticed that the curvature at *B* is large, that the knee of the curve is well defined, and that the part *C* is almost parallel to the line *O P*. Let *O M* represent the volts lost in the shunt wire; then *M P* will represent the volts on open circuit. In order to obtain steadiness, the point *M* must be chosen on the part *B C*, sufficiently far from the knee *B*. By so doing, the decrease of the magnetizing force due to the armature current will not lower the voltage to any great extent. Let *P P'* be this demagnetizing force, then *M' P'* will be the new voltage, differing but slightly from *M P*. For the same reason the armature resistance should be low and the shifting of the brushes be reduced as much as possible.

A dynamo built so as to secure these properties will meet the requirements.

To obtain these properties, proceed as follows: Have a relatively small air space between the pole pieces and the iron core of the armature; use powerful field magnets so as to keep the iron of the armature practically saturated; use a shunt wire of sufficiently large cross section to obtain the voltage *P M* on open circuit. Compounding in this case does not seem necessary, as a simple shunt gives about the same steadiness if the point *M* is properly located on the curve, as well as for other reasons.

Let us proceed now to the second case, of a dynamo for charging accumulators. As the counter electromotive force of the battery increases from 2.0 to 2.4 volts per cell. the voltage required for charging, say, 50 cells, will vary from 100 to 120 volts, a range of one-sixth. It is quite easy to see that the dynamo just discussed would not be appropriate for this purpose, where steadiness is not only unnecessary but must be avoided. If *M P* represents 100 volts. then to obtain 120 volts would require an enormous increase of exciting power, while, on the other hand, an attempt made to increase the speed, so as to give 120 volts without increasing the excitation *O P*, would probably lead to unsatis-

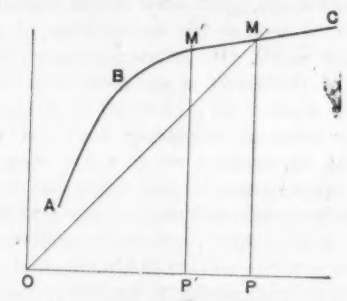


Fig. 1.—Dynamo Curves.

factory results when running at 100 volts, as the reduction of the excitation would give rise to bad sparking at the brushes. Therefore the design requires to be altered as follows: Increase the air space; increase the excitation; calculate the winding of the armature so as to give 100 volts without saturating the iron.

The characteristic curves ought to be something like those in Fig. 2, in which *A M* is the characteristic of the first machine, *A' N* that of the second, *M P* being 100 volts and *N Q* being 120 volts, the maximum voltage required.

Similar reasoning will give the conditions governing the design for other purposes.

Without attempting to exhaust the subject, let us consider two more examples, namely, constant current dynamos and transformers.

That a constant current dynamo requires an almost straight characteristic curve is well known. Their peculiarity is that the demagnetizing force due to the armature current becomes an essential feature. The usual terms magnets and armatures in these machines almost lose their meaning. The effective induction through the armature is now, as before, due to the magnetizing force of the magnet minus the counter magnetizing force of the armature; but the latter is now of great importance, as its function is to regulate for a reduction of the voltage, while that of the former is to provide for the maximum voltage of the

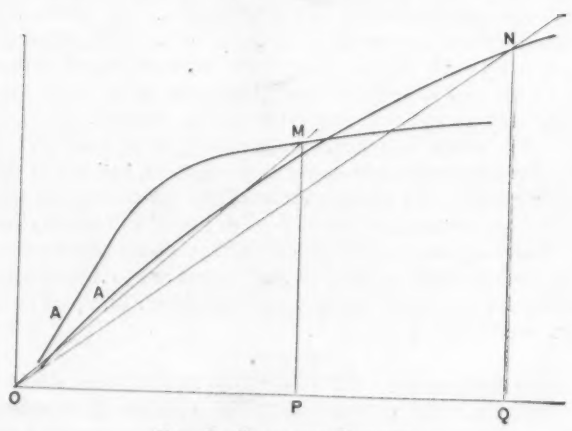


Fig. 2.—Dynamo Curves.

dynamo. In constant potential machines the aim was to obtain the desired voltage and current with the least possible armature reaction, that is to say, with the smallest possible number of turns of wire on the armature. In constant current machines the aim is to obtain a sufficiently low voltage by using the armature reaction as a counter magnetizing force to weaken the field. From this it is evident that the ampère turns on the armature must be about equal to those on the magnets. This and what has been said before concerning the characteristic curve should be used as the guide in designing such a dynamo.

Questions of a somewhat different character arise in other instances, as, for example, in transformers. Until recently, self-regulation and high efficiency were supposed to be the qualities required in transformers. Self-regulation practically means low internal resistance, or few turns of relatively stout copper wire. This case is, therefore, quite similar to that of a constant potential dynamo. Regarding the second point, namely, high efficiency, it means not only low internal resistance, but also low hysteresis; this in practice means that the iron should be as short as possible and have a cross section sufficient to keep the induction at a low degree. The full load efficiency was the main point considered, and when 95 or 96 per cent. was reached the designer was satisfied.

M. Dolivo-Dobrowolsky recently stated that this was not the right aim, and that the design would be better by paying more attention to the all-day efficiency. He points out that the watts dissipated by the iron losses are constant throughout the 24 hours, whereas the copper losses vary as the square root of the load. He therefore concludes that a much better mean efficiency may be attained by decreasing the iron and increasing the copper. He consequently reduces the iron in cross section, and increases the number of turns of the copper wire without increasing its cross section. Similar statements were made by Mr. Swinburne in advocating his "hedgehog" transformer. M. Dobrowolsky does not go as far, but retains the ordinary style of closed circuit transformer, in order, doubtless, to prevent the increase of current due to the lag, or to avoid the use of condensers. This reasoning seems correct, and the mean all-day efficiency will surely be higher than in the ordinary transformers, but, unfortunately, the self-regulation feature then disappears altogether.

I think that in most cases these principles are not quite right, and that the general rule given by Mr. Dobrowolsky is of use only in definite cases. The mistake is in looking at the transformer itself, without bearing in mind the kind of work which it has to perform. As far as lighting by incandescence is concerned, when the transformers are placed on the customer's premises, as is generally done, not only in America but also in Europe, the ordinary transformer with a high full load of efficiency is certainly the better, not because of its high efficiency, but on account of its better regulation. In the lighting industry, steadiness, that is, constant potential at the lamps, is the first condition to fulfill; high efficiency takes second place. M. Dobrowolsky argues as follows on that point: In every central station means are already provided for regulating the fall of potential of, say, five or six per cent. at least; it is therefore no difficult matter to regulate for an extra four or five per cent. lost in the transformer windings.

In so arguing he seems to have overlooked a most important point, that is, that the copper loss in the transformers is under the control, not of the station, but of the consumer. One transformer may be fully loaded, while the neighboring one is running only a few lamps. For what voltage would the station regulate? The resistance of the transformer windings is practically a part of that of the consumer's wiring; what would be thought, at the present time, of a district in which the consumer's wiring was intentionally made with a fall of eight or nine per cent. in the voltage?

If we suppose that the transformers are banked in substations the best results would be obtained by throwing them in or out at convenient times, as is well known. It seems, therefore, that the only conditions under which M. Dobrowolsky's suggestion holds good is when there is a secondary network, fed by transformers scattered throughout the plant, and almost out of reach. There, their internal resistance is practically a part of that of the distribution network, and may be regulated for in the station itself. It remains for the engineer to see whether this general arrangement is the best to choose under the given condition of a proposed plant.

Another favorable case is that of the transmission of power by alternating currents. But in such transmission the mean efficiency is always much higher than in a lighting plant, and the question is, therefore, of much less importance, as the two styles of transformers would come very near each other.

The few examples given above will, I hope, be sufficient to illustrate the statement made at the outset, namely, that a dynamo or transformer should be designed for every particular case, with a view to its particular application, and that the nature of the work to be performed must be the only guide for the designer.

Paris, October, 1892.

A New Conduit System for Electric Railways.

Among the numerous new devices suggested for overcoming the difficulties encountered in a slotted conduit, is an ingenious arrangement especially designed to keep the wires free from grounds in case the conduit is filled with water. The invention is that of Mr. R. W. Barkley, and consists in general of a conduit in which the wires are supported in the top of an inverted trough made in short sections with closed ends, but open at the bottom, so that, on the same principle as that made use of in the diving bell, when the water fills the conduit the air contained in the inverted troughs will prevent the water from rising to the height of the wire. No matter how much water there is in the conduit or in the street above it, the tops of these troughs containing the wires will always be filled with air, and the wires in them thereby kept from making contact with the water.

As these troughs must necessarily be in short lengths the trolley must be made to pass over the junction pieces, as it evidently cannot follow the wire through these partitions. This is accomplished by the use of two trolleys, one of which is always in contact while the other passes under the edge of the partition.

The device need only be used in such places where a long level line is liable to be flooded and there is no provision for quick drainage. Illustrations of this conduit may be found in *Engineering News*, Oct. 20, 1892.

THE action taken last week by the National World's Fair Commission in the establishment of rules for the government of the fair was of considerable importance. The committee of the National Commission appointed for the purpose considered the rules which were submitted by the Local Directory, and made what the chairman of that committee termed, "certain recommendations." These recommendations were in the form of an entirely new set of rules prepared by the Judiciary Committee, and dealt with the "rates of entrance and admission fees, and the rates, privleges and interests of exhibitors and the public."

According to these rules the gates will be open from 8 A. M. to 7 P. M. on each day of the week, except Sunday, from May 1 to Oct. 30, 1893, except when the management directs special evening entertainments, when the gates will close not later than 11 o'clock. The price of admission has been fixed at 50 cents. Children under six years of age, accompanied by their parents or guardians, will be admitted free. Exhibitors will not be charged for space, and a limited amount of power will be supplied gratuitously. One rule provides that any single piece or section of any exhibit of greater weight than 30,000 lbs. will not be accepted if machinery is required for its installation.

Rule 18 says:

"Exhibitors will be held reponsible for the cleanliness of their exhibits and the space surrounding the same. All exhibits must be in complete order each day at least 30 minutes before the hour of opening. No work of this character will be permitted during the hours the building is open to the public. In case of failure on the part of the exhibitor to observe this rule the chief of the department may adopt such means to enforce the same as circumstances may suggest."

The rules provide for a Bureau of Transportation, under the control of the director of works and subject to requisition from the director-general. Detailed regulations governing exhibitors were prescribed and the plan for the government of fire and police government specified in detail. The director-general and his chiefs are given exclusive control of the exhibition buildings in relation to the services performed therein, and then follow the charges to exhibitors for heat, power and light, and other special services. "All power service for generating light will be furnished during the exposition hours by the World's Columbian Exposition from the 1st of May to the 30th of October, 1893, at the rate of $8 per 16 c. p. lamp capacity, or the equivalent in lamps of other candle power. All changes in the location of lamps or appliances when once installed will be made subject to an extra charge to be fixed and determined by the director-general and the director of works. The incandescent lighting will be operated from 100 to 110 volt alternating circuits.

"All contracts to be made with exhibitors for power service shall be executed between said exhibitors, the director-general and the director of works, but the amount of power to be supplied to the exhibition in each case shall be fixed and determined upon by the director-general.

"The electric motor shall be suitable to operate on a 500 volt contant potential circuit.

"The rheostat shall be contructed wholly of non-combustible material.

"The main line switch shall be of the knife-blade type and suitable for working a 500-volt constant potential circuit.

"The motor shall be erected in position by and at the expense of the consumer, and in a manner subject to the approval of the director general and the director of works.

"The service connections to the motors shall be installed, maintained and owned by the World's Columbian Exposition.

"No service will be rendered for less than $20. Fractions of horse power will not be considered except for motors of less than 1 h. p.

"Charges will be made for service of connecting the main line at the following rates:

For one-half horse power	$10
For one to five horse power	15
For more than five horse power and not exceeding ten horse power	12
For more than ten horse power	10

"Charges for service will be based upon the maximum mechanical horse power delivered to the motor, irrespective of the class of work to be operated by motor, at the following rates:

For one-fourth horse power and less	$20
For more than one-fourth horse power and not exceeding one-half horse power	40
For more than one-half horse power and not exceeding one horse power	75
For more than one horse power and not exceeding two horse power	70
For more than two horse power and not exceeding three horse power	60
For more than three horse power	60

"Special service for motors not exceeding two horse power can be furnished on alternating current incandescent circuit.

"The aisles of the main building will be illuminated by arc lights, free of expense to the exhibitor. A limited number of arc lights will be supplied for private lighting on the following basis, viz.:

"The consumer shall pay the cost of wiring.

"The consumer shall pay for service from May 1 to Oct. 30, 1893, at the rate of $60 per lamp of 2,000 nominal candle power.

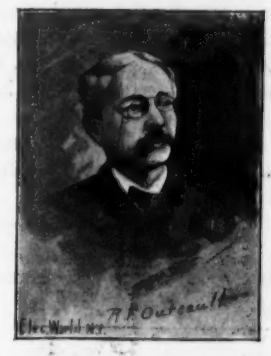
"Lamps will be suspended from the ceiling and furnished with opalescent globes. If any special fixture is required it shall be furnished by the consumer.

"All care and attendance to the lamps and circuits will be furnished by the World's Columbian Exposition without extra charge.

"Piping and all connections from main lines shall be supplied, directed and covered with non-conducting material by the consumer, subject to the approval of the director general and the director of works.

"Plans for the arrangement of piping shall be submitted by the consumer to the director general for approval before the agreement is signed.

"A rate of $40 per horse power will be charged for steam supply between the hours of the opening of the Exposition in the morning and 6 P. M., from the 1st of May to the 30th of October, 1893, except when it is otherwise ordered in case of special evening entertainments; but in case the exhibitor so elects, he shall be charged $60 per horse power for steam to be furnished during all the hours the Exposition is open from the 1st of May to the 30th of October, 1893.



HENRY VAN BRUNT,
Architect of the Electricity Building.

"The maximum rate of delivery to consumer's pipes shall form the basis of payment, irrespective of the class of work performed.

"The working pressure to be carried at boilers will be 125 pounds per square inch.

"Pneumatic power is calculated at a ratio equivalent to $60 per horse power delivered to consumer's pipe.

"Special rates are made for service in the electricity building, where only electric power is to be used.

"Storage on packing cases is at the rate of 50 cents for 27 cubic feet or less, and one cent per cubic foot for additional space."

The Fair will be open at night whenever the management sees fit, and the admission will be 50 cents.

Agricultural and Machinery Buildings. Administration Buildings. Mining, Electricity and Manufactures Buildings.

A GENERAL VIEW OF THE BUILDINGS ON THE WORLD'S FAIR GROUNDS.

Active work on the Fair Grounds has been resumed, and the construction work on many of the buildings is being rapidly pushed toward completion.

The accompanying illustration gives a very comprehensive view of six of the most important buildings. The one shown at the extreme left is the Agricultural Building, while next to it is Machinery Hall, and at the centre of the illustration is shown the Administration Building. The three structures on the right are the Mining, Electricity and Manufactures buildings, the last named being the one on the extreme right.

Irregularities of Street Lighting Service with Arc Lamps.

BY PAUL LÜPKE.

In the following I purpose to give some accurate figures in regard to all interruptions of service in furnishing about 200 arc lamps for street lighting, covering a period of one year from August, 1891, to July, 1892. The contract called for "all night and every night" service.

First I will say a few words about the general arrangements of lamps, lines and power station. The lamps are all hung from mast arms. They are of different make, but the majority are 15 and 18 foot arms of the Star Iron Tower Company's make. The lamps are distributed on five separate circuits, which include, besides the street lamps, about 40 lamps for commercial purposes. The total amount of wire on these circuits is 47½ miles. Every wire entering the station passes through a lightning arrester of Thomson-Houston make with a magnetic break, but there are no lightning arresters on the line.

Each circuit is run by a No. 8 Brush dynamo of 9.6 ampères. Four of the dynamos are belted in pairs direct to two high speed engines of the self-contained Buckeye type, while the fifth is belted in the same way to a third engine, which also drives a 6.4 ampère Brush dynamo, used for commercial lights only. There is no spare engine in use at any time, and no spare dynamo, except, perhaps, on Sunday nights, when it is possible to combine two circuits by sacrificing a comparatively small number of street lamps, as most of the commercial lamps are not in use on Sunday.

A traveling crane is arranged over the dynamos in such a manner that an armature can be changed in about 20 minutes by the regular station attendants. The engines are connected to a main steam pipe leading to a drum over a battery of eight boilers, from which battery are also fed six other engines driving incandescent dynamos and power generators.

The necessary data to make up the accompanying table are compiled from carefully kept daily station records. Of these records one sheet arranged graphically shows at a glance everything concerning the output of the station for 24 hours. An account of interruptions of a general character, such as the break down of a dynamo or engine, or the opening of a circuit, is obtained from these sheets, while trouble with individual lamps is extracted from a record kept at police headquarters, which record is made up from daily reports of all police officers. It is one of the duties of the officers to report all lamps not burning properly.

INTERRUPTIONS OF STREET LIGHTING SERVICE FOR A PERIOD OF ONE YEAR, AUGUST, 1891, TO JULY, 1892.

Month.	Number of Lamps.	Burning time per lamp per month.	Burning time per lamp per night.	Total lamp hours per mont h.	Interruptions due to disarrangement of						Loss in per cent. of total lamp hours.					
					A Lamps.	B Lines.	C Dynamos.	D Engines.	E Piping.	F Total.	A.	B.	C.	D.	E.	F.
1891.		H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.	H. M.						
August	189	292 30	9 26	55,282 30	73 10	none	none	none	none	73 10	0.132	.....	.....	.....	0.961	0.132
September	189	312 20	10 25	59,030 56	26 10	"	"	"	567 00	593 10	0.044	.....	.....	.....	.....	1.005
October	189	365 45	11 48	69,126 45	77 15	"	"	"	none	77 15	0.112	.....	.....	.....	.....	0.112
November	189	386 50	12 54	73,111 26	64 15	"	"	"	"	64 15	0.088	.....	.....	.....	.....	0.088
December	189	419 50	13 32	79,348 26	57 20	"	"	"	"	57 20	0.072	.....	.....	.....	.....	0.072
1892.																
January	189	412 27	13 18	77,953 00	106 47	98 00	23 45	"	"	228 32	0.137	0.126	0.030	.....	.....	0.293
February	193	363 00	12 31	69,278 00	62 40	none	none	16 00	"	78 40	0.090	.....	.....	0.023	.....	0.113
March	198	344 10	11 06	67,906 45	102 25	16 21	"	50 00	"	168 46	0.151	0.024	.....	0.073	.....	0.248
April	203	291 25	9 42	58,841 35	40 30	none	"	none	"	40 30	0.079	.....	.....	.....	.....	0.079
May	204	269 50	8 42	55,009 15	20 15	10 30	"	"	"	30 45	0.037	0.019	.....	.....	.....	0.056
June	205	242 30	8 05	49,477 55	17 30	none	"	"	"	17 30	0.035	.....	.....	.....	.....	0.035
July	206	259 30	8 22	53,400 15	103 15	"	"	"	"	103 15	0.193	.....	.....	.....	.....	0.193
Average for the year	....	330 01	10 49	63,980 34	61 38	10 24	1 59	5 30	47 15	127 46	0.097	0.015	0.002	0.008	0.080	0.202

The table will explain itself, and I only want to call attention to and make a few explanatory remarks about some of the more conspicuous figures.

The interruptions charged to individual lamps reach a maximum in January, considering the actual time lost, while the highest percentage of loss falls in July. The one is due to continued severe winter weather, while the other was caused by a number of sharp thunder storms, which followed each other in close succession. The loss at any time does not quite reach one-fifth per cent.

The 98 hours charged against lines in January, 1892, were lost through the opening of one of the circuits at 3 A. M. The break was repaired in one hour and 50 minutes. The other two losses in column B were occasioned by fire. The wires had to be temporarily cut out of the way of the firemen.

The only charge against the dynamos, also in January, 1892, was caused by a bad short circuit at the commutator, making it necessary to change the armature.

Column D, engines, shows two interruptions, which were both due to a slight disarrangement of the cut-off valve.

The loss of 567 hours in column E (September, 1891) was brought about by a general shutdown at 2 A. M. to replace a defective section in the main steampipe. As this matter was prearranged with the proper authorities and was done to remove the possibility of not being ready to start up in time in the evening, it can hardly be called an accident. However, it shows plainly what a disastrous effect a shutdown of a few hours has upon the running record. It brings up the percentage of loss for September to one per cent. and the total average for the year to one-fifth per cent., which latter figure would be about one-eighth per cent. without it.

American Institute of Electrical Engineers.

At the monthly meeting of the Council, held at 12 West Thirty-first street, New York City, Oct. 25, the following associate members were elected: Bion J. Arnold, General Electric Company, Chicago, Ill.; D. Herbert Jeffery, Crocker-Wheeler Electric Company, New York City; Julius Meyer, North American Company, New York City; F. S. Pearson, West End Street Railway Company, Boston, Mass.; George Jarvis Spencer, The Yale & Towne Manufacturing Company, Stamford, Conn.; Walter H. Tapley, Government Printing Office, Washington, D. C.; Gurdon C. Van Buren, Albany, N. Y.; Geo. S. Wallace, Chesapeake & Ohio Railway Company, Clifton Forge, Va.; Norman R. Weaver, General Electric Company, Chicago, Ill.

The following associate members were transferred to full membership:

Clayton W. Pike, Jas. W. Queen & Co., Philadelphia, Pa.; Jas. D. Bishop, J. A. Roebling's Sons Co., New York City; E. T. Barberie, Safety Insulated Wire Company, New York City; Richard O. Heinrich, Weston Electrical Instrument Company, Newark, N. J.; Frank B. Rae, Detroit, Mich.

At the meeting of the Institute in the evening the three electric railway papers read at the general meeting in Chicago last June were discussed. The titles of the papers are as follows: "Series Electric Traction," by Mr. Nelson W. Perry; "A New System of Electric Propulsion," by Mr. H. Ward Leonard; "Electric Railway and Motor Tests," by Prof. Geo. D. Shepardson and Mr. E. P. Burch. The discussion was opened by Dr. Cary T. Hutchinson and continued by Messrs. Sprague, Mailloux, Emery, Crocker and Henshaw.

The report of the Committee on Units and Standards was accepted and referred to the Sub-Committee on Provisional Programme for the International Electrical Congress of 1893.

On the Physics of Cataphoresis.*

BY A. E. KENNELLY.

The cataphoric action of electric currents, sometimes named electrical endosmose, whereby a liquid is electrically tranfused through a porous septum, was discovered by Reuss. The history of this phenomenon with its anomalies and complexities, that for many years baffled analysis and exhausted conjecture, but finally yielded before persistent research, forms an interesting epoch of the century. It was the measurements of Wiedemann, published in 1852, which evinced the principal laws controlling the action and which were corroborated later by Freund and others. Quincke appears in 1861 to have first given that theory of the subject which was extended and more fully developed by Helmholtz in 1879 and which remains in vogue at the present time. The best description and account of Cataphoresis is to be found in "Die Lehre von der Electricität" vol. ii., chap. iv., (Brunswick, 1883), by G. Wiedeman, whose above mentioned researches have had so important a share in the development of the subject.

When two liquids similar or diverse are brought into communication through a narrow channel of insulating material (such as a capillary tube of glass), or by a combination of narrow channels in non-conducting material (such as exist in aporous diaphragm of earthenware, wood, porcelain, parchment, membrane, etc.), and an electric current is passed from one vessel of liquid to the other through the tube or diaphragm, a flow of liquid generally accompanies and in the same direction, that is, from the vessel where electrical condition is conventionally described as positive to that which is negative, and the liquid accumulates around the cathode. If the two liquids are dissimilar there will be a movement across the common boundary before the current passes and due to that diffusion which, as we know, is a property of dissimilar fluids at confluence. Also, if in virtue of any difference of level in the vessels the liquids were not in equilibrium of pressure at the point of communication, there would be a motion in the tube or a tendency to restore equilibrium in the ordinary way; but on passing the electric current, it is assumed from experimental results that the flow due to electrical endosmose is simply superimposed upon such diffusion of gravitational currents as may happen to exist. In measurements of electrical transfusion, it is therefore essential that these extraneous influences should be either entirely eliminated or duly taken into account.

Rare cases have been observed in which the electrical transfusion either opposes the electrical current in direction, passing from the negative to the positive liquid, or assumes the intermedial condition of failing altogether in appearance. Given a definite porous septum and liquid in its pores the total quantity of liquid electrically transferred depends only on the total quantity of electricity transferred, and at any instant the liquid current is directly proportioned to the current of electricity, so that to effect a certain transfer of liquid a weaker electric current must be sustained for correspondingly greater time. The thickness of the diaphragm did not come into consideration, as the amount of liquid transferred depends upon the substance of the diaphragm.

The accepted explanation for cataphoresis is based upon the same electrostatic force and motion by which Thales first discovered and placed electricity upon record and by which light particles, pith balls, gold leaves, etc., are made vehicles of energy when electrified and brought into the vicinity of electric charges.

It was observed by Faraday that water by contact or friction with other substances became positively electrified in all the trials to which he subjected it, and its positive nature as an electric was more distinctly characterized than even that of the proverbial catskin. This property accounts for the general tendency of aqueous solutions to move from the anode toward the cathode in cataphoresis down the gradient of electrical potential. Independent observations upon the movements of fine particles suspended in glass tubes filled with liquids and traversed by electric currents have supported this view.

It is evident, according to the same theory, that for a given diaphragm substance, aggregation, density and size of capillary tubes as well as liquid within them, the transfusion per coulomb of electricity or the rate of transfer per ampère will be directly proportional to the resistivity of the liquid, since on this will depend the form of potential in the tubes. The higher this resistance of the liquid the greater must be the electrical pressure between the surfaces of the diaphragm, to maintain the same current strength, and the moving force upon the liquid particles will be augmented in corresponding measure. The resistivity of the liquid is advantageous in, and only in, the diaphragm, for resistance offered to the passage of the current by the liquid masses on each side of the septum will demand a certain increase in electromotive force to be expended locally in themselves, without any addition to the cataphoric transfer. Consequently the conditions for producing the greatest transfusion, with a given number of volts pressure, would be to place the electrodes as near as possible to the diaphragm on each side of it so as to develop almost the entire difference of potential within the capillary tubes and to produce the greatest available current strength. The area of diaphragm service involved does not, as we have seen, affect the rate of transfusion, but only the rate of transfusion for unit of area, so that it might still be independently advisable to keep that active surface above a certain limit lest the density of current in the tubes might develop too much heat or be otherwise detrimental.

Whenever it is desired to produce the greatest possible transfusion of an aqueous solution of any salt, for a specified electrical transfer in coulombs or ampère-hours, the solution should be as weak as possible, so as to increase its resistivity, since pure water is almost a non-conductor. When, on the contrary, the greatest transfer of the dissolved salt and not of liquid merely is needed, a very weak solution is evidently no longer indicated. Wiedeman's experiments on solutions of salts show that roughly the transfer of liquid was inversely proportional to the percentage of solid contents. If this was strictly true the strength of solution would evidently be a matter of indifference, since doubling the solid contents of the solution would just halve the liquid transfer and leave the transfer of dissolved substance unchanged.

To a first approximation, therefore, the strength of solution does not alter the transfer of solid matter per coulomb, and with a given diaphragm and solution everything depends on the strength of current.

Strictly speaking, however, this rule is far from being clearly defined, for on the one hand the conductivity of aqueous solutions of salts generally increases more slowly than the percentage of solid contents, so that on this account it would be advantageous to employ stronger solutions for a maximum transfer of the salt per coulomb. On the other hand the effect of increasing the strength of solutions is not yet clearly determined, and the loss in moving force might in strong solutions more than offset the gain in greater resistivity per solid contact, especially as a great frictional force retarding the motion might also be looked for. In experiments of Freund with earthenware diaphragm, the transfusion increased with moderate densities of solution $CuSO_4$ and $ZnSO_4$, but on the contrary with $Cu(NO_3)_2$ and $Zn(NO_3)_2$ weak solutions appeared to possess the greater transfusive constants.

* Abstract of a paper read before the American Electro-Therapeutic Association.

The Generation of Ozone by Electricity.

BY DR. L. K. BÖHM.

The recent convention of the American Electro-Therapeutic Association at the Academy of Medicine in New York had among its exhibits an ozone machine, exhibited by the Ozone Manufacturing Company, of New York, which attracted considerable attention on account of the elegant finish of the apparatus, the striking sight of the silent electric discharge in the ozone tubes, which is of a magic violet, and perhaps because the application of electricity for the production of unlimited quantities of ozone is relatively new and was—in its present state of perfection—unknown to most of its visitors.

Ozone, as is well known, is an allotropic modification of oxygen. Ordinary oxygen contains two atoms of oxygen to the molecule, while ozone contains three, and it is this third, rather loosely combined atom, which is the so-called "active oxygen" that gives to ozone that peculiarly great reactive power by which it is distinguished from ordinary oxygen. Although ozone was discovered as early as 1840 by Prof. Schönbein, of Basel, who then published (*Annalen der Physik und Chemie*, April 8, 1840) his observations on the odor produced by the electrolysis of water, it has only quite recently become possible to generate ozone in unlimited quantities. There are chemical and electrical methods to produce ozone. As the chemical methods yield but small quantities, it was reserved for the electric methods to lead to practical results, and to-day the applications of ozone in form of specific remedies in medical science, for disinfection and in chemical laboratories as a strong oxidizing agent, are quite numerous.

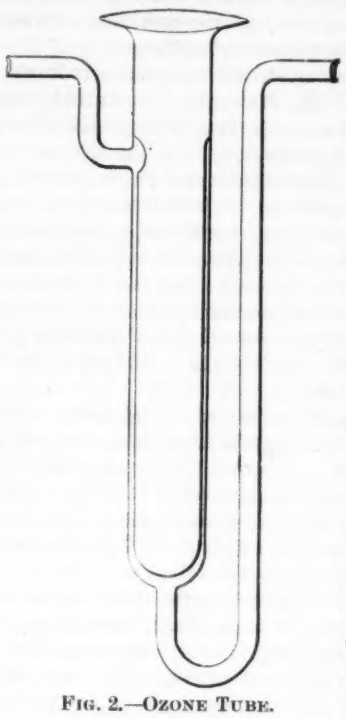


FIG. 2.—OZONE TUBE.

Since Schönbein discovered ozone in 1840 by the electrolysis of water, hardly any progress was made in the production of large quantities, up to about 1885. A number of experimenters observed the formation of ozone by chemical processes, and by the various discharges of electricity in the air or in oxygen. The oxygen of a slow current of air is partly ozonized when passed through a tube filled with moist pieces of phosphorus; ozone is also formed when a strong current of cold air is passed through the small flame of a Bunsen burner or a hydrogen flame, or if strong sulphuric acid acts on dioxide of silver, barium, manganese, etc.

The peculiar smell occasionally observed near high tension electrical machines at work is due to the formation of ozone; following a discharge of lightning, that is, an electric discharge of atmospheric electricity through the air, the same smell, due to ozone, is sometimes noticed, and as was stated, ozone is formed by the electrolysis of water. All these methods produce but small quantities. The great step in the progress of the art was made by the celebrated Dr. Werner von Siemens, who discovered that by the silent electric discharge much more oxygen is transformed into ozone than by the intermittent discharge. The electricity must be of high tension and the ozone generator must offer high resistance, in order to facilitate a productive discharge, and the well dried air or oxygen, while passing the generator, must present as large a surface per volume as practically obtainable.

To meet all these conditions Siemens soon constructed proper electrical apparatus, among others an ozone tube, which was improved by Von Babo and later on again by Siemens. With these high tension apparatus and the modern ozone tubes of which a set—say of five or so—is called a battery, unlimited quantities of ozone are produced abroad and here, although it is impossible to transform all the oxygen into ozone.

Ozone has, furthermore, been generated by passing a current of air or oxygen between two glass plates, the glass plates being covered on the outside with metallic discs which were connected by wires with the source of electricity. The silent discharge taking place between the two glass plates traversed the current of air or oxygen which passed between the plates and converted part of the oxygen into ozone.

In this country the Ozone Manufacturing Company, of New York, is the only company producing ozone commercially, and their apparatus, exhibited at the meeting of the Electro-Therapeutic Association at the Academy of Medicine, will, therefore, be described here a little more in detail. Dr. Dietrich, superintendent of the Ozone company, explained and operated the apparatus, which is of the type manufactured for purifying the air in large buildings. This machine, which takes up but very little room, consists of an electric motor, a blower, an arrangement for drying the air, a transformer and the ozone generator. (See Fig. 1.) The small motor is operated by current from any available source; in this instance a branch of the 110-volt incandescent current in the building was utilized. The motor works the blower, which forces the air from the atmosphere through specially constructed drying tubes containing glass pearls saturated with sulphuric acid. The well dried air then passes through the ozone generator, and from there escapes through outlets into the rooms. The transformer, which is a novel construction of Mr. Anderson, electrician of the company, brings the 110-volt current up to from 8,000 to 14,000 volts. This high tension current is conducted to the ozone tubes, where the silent discharge takes place, traversing the space between the walls of the tubes where the air passes, ozonizing the same.

Fig. 2 shows such an ozone tube, of which a battery of seven was employed in the apparatus. The tube consists of two parallel tubes of thin glass, forming two separate spaces. The inner tube is filled with water, into which dips an electrode. The space between the outside and inside tube is the part traversed by the air, and it should be very small, so as to give the air, while under the action of the silent discharge, as large a surface per volume as possible. A number of these tubes are put into a big glass jar, which is partly filled with water, in which is placed the other electrode. The current passes from the transformer into the inner part of the tube, discharges silently through the glass walls and the space between them, and returns through the second electrode contained in the liquid of the glass jar. The silent discharge is of a magic violet, which, when closely examined, looks as if thousands of violet needle points were traversing the space.

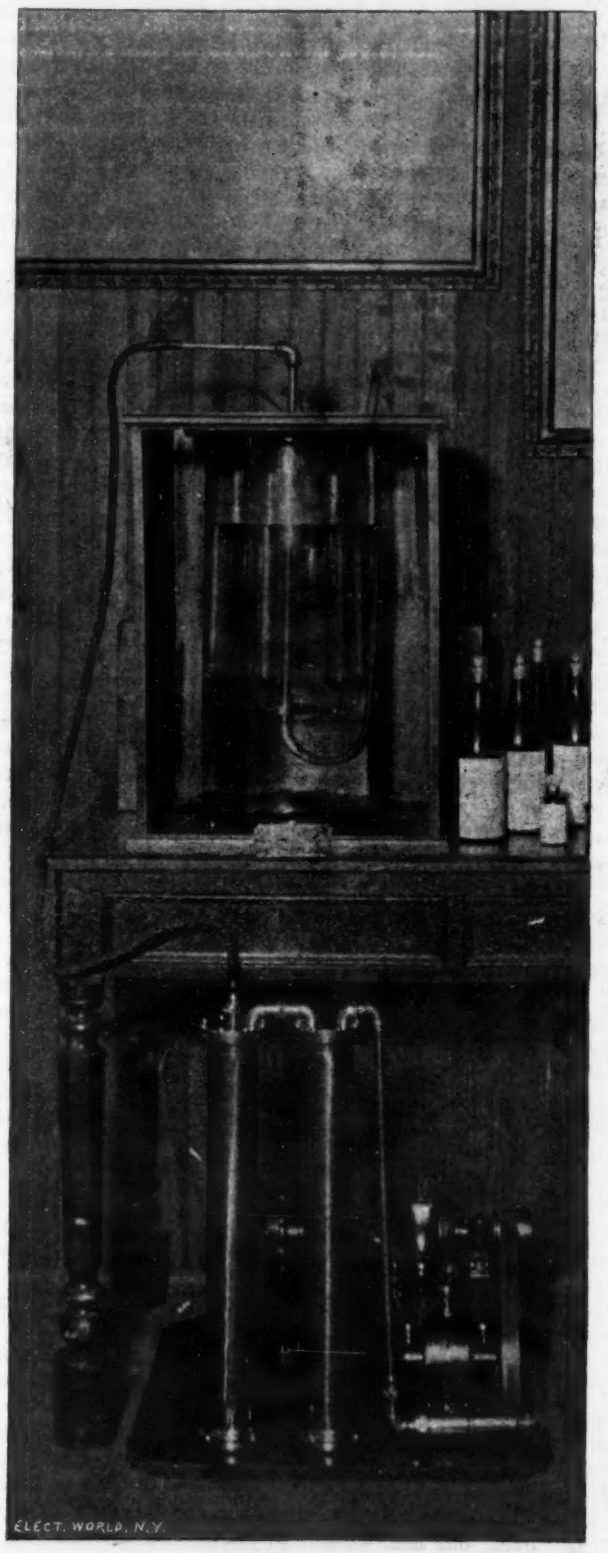


FIG. 1.—APPARATUS FOR GENERATION OF OZONE.

One of the above described machines is, for instance, at the Wellesley College in Boston, where it serves for purifying the air in the drawing room, chapel, library, etc. Among the number of ozone remedies exhibited were aquozone, that is, ozonized water (2.5 vol. per cent. of ozone); aerozol, for disinfection, is a strongly ozonized group of essential oils (25 vol. per cent of ozone); kodozonol, ozonized oil of tar, etc. But these are more interesting to the medical than to the electrical profession.

Safety from Electricity.*

BY PROF. LUCIEN J. BLAKE, OF THE UNIVERSITY OF KANSAS.

That electricity can produce fire and death is a fact. How it produces each is generally a matter of conjecture. That electricity is always looking for escape to mother earth is also a fact. Why is usually also a matter of conjecture. Excessive heating of some portion of a circuit originates fire; while the effect upon the nervous or circulatory systems is variously given as the cause of death. If a current can only be confined to any chosen path, the question of safety is simple. This means the study of insulation. But even then a current properly confined may so heat its circuit as to eventually cause fire, and this means, then, a study of the conducting circuit. Then, again, a circuit safe for one current may prove dangerous with another, and this involves a study of currents. The question of safety depends upon the conductor's insulation and current. Now, it is not my purpose, nor is it necessary before the experienced members of this association, for me to take up all those details of insulators and conductors which the best practice of to-day embodies. The rules of the Board of Underwriters of all our largest cities are in quite general agreement, and represent the experience and tests of many years. Still the number of fires from electricity seems to be increasing. In seeking a cause for this I want to speak preliminarily, however, of what is meant by conductors and insulators, why a current runs off to the earth, and what a current of electricity is anyway—at least as far as science can now say. These are questions which interest many of us, and the answers to them are helping electricians and inventors to-day, and should assist us in guarding against dangers from electricity. I trust it may not be out of place then, at the start, to present recent views on electricity in studying safety from it. The man versed in both theory and practice is to-day the most successful. Telegraphing without wires, electric lighting without filaments or even conductors, the bringing of Niagara's energy in lumps of 5,000 h. p. each on a single wire into the streets and factories of Buffalo, originated and will be made possible because of our modern conceptions of electricity. The better, then, we understand the nature of electricity, the better can we understand and guard against its dangers. I have the feeling, too, that scientific knowledge belongs to the people at large, and late discoveries and ideas ought not to be locked in laboratories and lecture rooms, or covered too much under technical words. It may not be unwise, then, to take such an occasion as this to state as introductory wha the most advanced electricians believe.

It has long been known that an electrical current acts outside its circuit. The cross talk in telephones—their buzzing after the electric lights are on—telegraphing between moving trains; all depend upon the influence of the current outside the circuit. Remove the air around the circuit, and the effects are unaltered. Now, nothwithstanding the metaphysicians, we cannot think of these effects taking place without there being something besides air there. This something we call the ether, and we have a great many reasons for knowing it really exists and also something of its properties. For example, we know that all but just a small per cent. of the power of electricity is in reality some kind of a disturbance of the ether immediately adjacent to the circuits. So that it is wholly erroneous to consider the electric power for our motors or electric lights as traveling in the slender wire of their circuits. In reality it goes along in the space, *i. e.*, the ether, around the wire. One of the most marvelous things, too, is the fact, that all this power, oftentimes many hundred horse power, will pass unhindered through all apparent obstructions. Where a wire enters a building there the power follows, through the walls, along the floors, even through our bodies, its presence unsignaled and, for hundreds of years, not suspected. At the dynamos the ether receives its initial charge of electrical energy, and this being continually renewed as it is sent out through the ether, is converted into power at our motors, and into light at our lamps. Just as enormous power is transmitted by water waves, without the water as a whole moving from its position, so power is transmitted by means of ether motions without the ether as a whole being disturbed. Now, as we know no substance can wholly prevent this transmission of electrical power through it, it proves that the ether prevades all substances. In the wire, in its insulatory sheath, and in the space around it, often to a mile and even more away, the ether is disturbed, and all electrical and magnetic phenomena are essentially embraced in that disturbance. We must enlarge our conceptions then. Only the smallest part of the electric current is in the wire itself. Where the ether is embedded in a substance there it is affected by that substance, so that its movements are modified. This implies an interaction between the material and the ether, and we are justified in expecting this action to be different for different substances. In fact we have learned by experience that all bodies may be divided into two great classes, conductors and insulators, according to their difference in action. Conductors vary greatly among themselves, as do insulators: no two bodies are electrically exactly alike, and there can be no perfect conductor, nor any perfect insulator. Further, we know that an ether disturbance originating at a battery or a dy-

* Abstract of a paper read before the Association of Fire Underwriters of Missouri, Kansas and Nebraska.

namo is not propagated out and away from it unless there is a certain kind of substance which shall form a continuous line of direction from the originating parts of the dynamo or battery back to the same. We used to say there must be a conducting circuit from starting point back to same. Now we say there must be something to indicate the direction which the ether disturbance shall follow and the circuit does this. The conductor is the line of direction; the ether movements round about it constitute the true electric power. Electricians think now of the ether as of primary importance, the conductor is somewhat incidental.

Now the material of the conductor seems to have such an effect upon the ether imbedded in it as to retard any motion given to it. Whenever we meet with a hindrance to motion, there we recognize friction, and friction always causes heating. The heating of conductors arises from the fact that the ether within them cannot freely execute its motions. That impeded portion develops heat. The true current which really lies all about the conductor expends but a small portion of its energy in heating the conductors, and that portion we measure and generally think of as the current. The more power we originate in the ether the greater is the conductor's portion going over into heat, until it may mechanically break down by melting and causing fire.

Now, let us go a step further. The earth as a whole is an immense conductor. Of such size it offers but little hindrance to the entrance of an ether disturbance into its substance. It is like the ocean in which all rivers lose themselves. Grounding a circuit is providing a directing line for the ether motion into the earth. But two grounds are always necessary, for we have seen the ether motions must be brought back to the place of origin, *i. e.*, they must be a continuous circuit. Now, the property of an insulator is to hinder the propagation of the ether's disturbance. There is no substance yet known which will do this absolutely, and yet if the ether disturbance be sufficiently intense it will break down all substances. Here we find the distinction between the conductors and insulators, and here we recognize the problem of insulators the electrician has to deal with. I will not follow this problem in any of its details. It is two-fold, electrical and mechanical. Good conductivity and high insulation form the electrical; resistance to abrasion, to water and to fire the mechanical. The problem has been successfully solved, too, so that we can obtain perfectly safe wire, if we wish it. However, these primal qualities for safety are embodied only in a few wires, such as Okonite, Simplex, Kerite, made in factories of recognized reputation. I call attention here to laboratory tests which are frequently published as indorsements of wires. An insulated wire tested when first sent from the factory is generally very different from one which has been exposed to service for some time. Cheap wire when new frequently shows good laboratory tests. I have found new wires at first equally good in the laboratory, showing, three of them, absolute danger in their insulation after six months' service. The first consideration in reducing fire risks from electricity is to insist upon the purchase of wire of reputation, and this means a good price for it.

The next point necessary for safety is of paramount importance—the actual wiring. Here, I believe, the chief danger lies, and here, too, associations like yours have the opportunity of helping remedy an increasing evil. The dangers of wiring, as you know, are generally concealed, the joints, the taping, contacts with water, steam and gas pipes, the passing through walls and partitions, all these I need not mention in detail. I believe, however, that all these dangers from electric wires, with hardly an exception, arise from incompetent, underpaid and conscienceless workmen. I have here some joints I want to show you which I cut from the circuits of a neighboring city. They are types of work done by ignorant or irresponsible workmen. You cannot afford to take risks in buildings wired in that manner, and yet such are not uncommon about us. Now why are they common? I believe because men, cheap in every sense of the word, did the work. Outside of our cities any one is allowed to put up wires without inspection, while wiring, above all things, should demand skilled labor and be paid as such. The electrician and the factory can and do provide safe wire, having the requisite electrical properties. But they cannot render it safe under improper wiring. Here the construction company becomes responsible; I believe, then, that the increasing number of fires of electrical origin comes chiefly from imperfect construction work. The work is allowed to be poor and dangerous, because owners of buildings are indifferent and do not know what good work is. You may say we have authorized inspectors. Any building can be imperfectly and dangerously wired even with the best inspectors about. Unless an inspector sees every joint, every fuse and every wire laid (and this, of course, is impossible) he cannot be assured of reliable work. He depends upon the faithfulness of the construction company. That company practically relies upon the skill and faithfulness of its individual workmen. Here in this low grade of electrical work is the source of danger. Some companies pay a workman so much per lamp wired, and the day's wages thus depend upon how fast he can work. This materially jeopardizes the character of his work. Others may take any workmen if they can only hire them cheaply enough. There is little inducement for bright young men willing and wishing to work their way upward to becoming expert electricians to enter most of our construction companies. Conscience in this lowest grade of electrical work is needed, and to get it better men must be had, and to get them better wages must be paid. I do not see how we can expect safe work or fires from wires to diminish until we can compel by legislation every workman who does actual construction work to pass an examination before some proper board and be licensed. Even then we could not be assured of honest work, but we would prevent ignorance, and that is a step in the right direction. Construction companies would object, contractors and owners of buildings would object, because it would cost somewhat more to wire our buildings. I think, however, there is power enough in such associations as yours, if you wish, to greatly remedy the evil which I cannot help feeling is the chief root of danger in electrical work. Ten years ago electrical companies did their own construction work. To-day hardly one does. The manufacturer of electrical material, the supply agents and the construction company are now wholly independent, and upon these the one on which rests the greatest responsibility for electrical work which shall be safe is the construction company.

My students, who have begun their commercial electrical work with construction companies in Chicago, New Orleans, St. Louis and some Eastern cities, have frequently written me of their surprise at the careless and dangerous work allowed. They have frequently been answered: "Oh, if anything happens there are a hundred different causes to suggest as the true one." What sort of an introduction is that for young men whom all our technical schools are trying to make skilled and, above all, honest electricians?

I am not sure as to the best method to secure such protection by statute. But if we expect to reduce the number of fires and of other dangers arising from the introduction of electric currents we must insist that only those competent by training, experience and, above all, by honesty in work should be allowed to install or to manage electric appliances. You, gentlemen, not only for your own professional interests, but also as citizens, have the opportunity of uniting with our best electricians and manufacturers of electrical appliances, who on all hands are crying out against imperfect construction work from untrained, poorly paid and conscienceless workmen. I enter a plea for rigid license and more conscience. It is in the power of your organization to do much here. With our increasing knowledge of the subtle and dangerous ether disturbance called electricity; and with improved insulatory and safety devices, the public has a duty to enforce by its laws, in the proper placing and after care of that which the electrician provides, and we as citizens should acquaint ourselves with the theories and facts about electricity as well our best authorities can give them. Then we may expect the number of electrical accidents to diminish instead of increase.

Now, I do not wish to put all the blame upon incompetent workmen who put in the plant. A plant safely and properly installed needs most rigorous and constant inspection afterward. That is the duty of electricians in charge, and the same demand for conscience with skill must be urged here. Fortunately matters are generally better here. Still I think those in charge of electric plants—whether central or isolated—should be required to hold licenses just the same as steam engineers. Here again you can assist in establishing safeguards against electricity by laws of license. In fact I do not know of any industry where skill and honesty should be so secured by law and penalty (and I might add by good wages) as that which controls the introduction and maintenance in our buildings of that subtle and dangerous ether disturbance we call electricity.

After this brief and incomplete outline of the part played by the conductor and insulator in safety from electricity, I beg your indulgence to give just a few statements about the current itself. There are different kinds of currents—*i. e.*, different kinds of ether disturbances. In direct currents the ether completes its motions in one direction. In alternating currents the ether's motions are reversed as many times per second as there are alternations—two hundred or more in a second. There results a sort of mechanical jarring to the ether, which is shared by the conductor and its insulating sheath. Thus, the insulation seems to be under greater tension. Fortunately, however, our best wires easily withstand it, and alternating currents inside our buildings are not a whit more dangerous than direct currents are.

But a new source of danger enters when the alternations are millions to the second and are intense. We do not have such currents commercially produced, but the lightning bolts are types of them. It becomes an important question—are there any improved methods by which we can diminish fire and death hazards from lightning? There were 205 deaths recorded from it in 1891, to say nothing of many fires.

Of late years our ideas about lightning have changed much, and, consequently, also in regard to lightning rods. We now know that lightning consists of powerful and exceedingly rapid surgings to and fro of the ether. These take place along the path of the stroke, and extend away from it often far and wide in all directions. These surgings may be directed into the earth by a conductor, but they are so rapid and powerful that the material of the conductor is of little moment. Anything in their passage may be affected, heated and ruptured. The questions are frequently asked, "Do rods protect? shall I put them up, and if so, what kind?"

For buildings in cities except churches and other high structures, rods, I think, are unnecessary. Lightning strikes seldom in the cities compared with the country, one reason being that the many electric wires—telephone and telegraph and electric light—are really safeguards. A building is safer with such wires over it than without In the country, however, buildings may need protection. Our knowledge of the nature of lightning indicates the method, and this, however, need not be expensive. Here, too, it seems to me, fire underwriters could reduce their fire risks and assist the farmers materially. If associations like yours should adopt rules governing the placing of lightning rods on buildings to be insured in the country as you have for electric wires, these rules based upon the best knowledge and experience of electricians, then would the risks of lightning diminish and the farmer be saved many expensive impositions. It has always seemed strange to me that we do not promulgate in some way reliable rules and information about lightning rods, and not leave the opportunity to irresponsible parties, as is now quite generally done, to force their own theories and their own expensive systems of rods upon the helpless farmer.

Our modern conceptions of lightning indicate in general somewhat as follows: For the rapidly oscillating current the surface of the conductor first receives the ether disturbance and becomes heated, so that the interior makes but little difference. A good large surface is needed, and iron rods are just as good as, if not better than, copper. The old idea of a copper rod to earth, large enough not to become overheated, would be correct if the lightning were a direct current as formerly held. But for its rapid surgings there must not only be the conductor, but surface to it, and good grounds; furthermore, all large bodies of metal in the building must be connected to it, or, better, provided with independent grounds.

A danger only recently explained in lightning rods occurs from side spittings of sparks from the metal, and fires have frequently arisen in this way. These are the results of the great strain upon the ether lying near the rods, and there is no absolute protection known against them.

In fact there is no perfect safety from lightning because of the large area over which the ether is disturbed. For the individual the safest place is in the centre of the room, and on the floor. There he is farthest removed from the most direct path of the ether's violent surgings. But rules simply expressed and enforced as conditions of insurance will do much toward lessening accidents of fire and death from lightning.

It would seem that if we would reduce the accident hazards from electricity, we need more rigid applications of good rules of installation; we need more skill and conscience in those to whom are intrusted the actual placing and handling of the increasing number of electric appliances all about us. The best powers to reduce, in this way, life and fire hazards from electricity are, after all, associations of fire underwriters like your own.

Chronological History of Electricity—Part II.—1800-1820.

BY P. F. MOTTELAY.

OUNG (Thomas), M. D., a very celebrated English scientist, "eminent alike in almost every department of human learning," who was the associate of Davy at the Royal Institution, and who became the successor of Volta as Foreign Associate of the French Academy of Sciences, publishes his very elaborate "Course of Lectures on Natural Philosophy and the Mechanical Arts," upon which he was assiduously engaged for five years, and a new edition of which was issued (with additional references and notes) by the Rev. P. Kelland, M. A., F. R. S., during the year 1845.

The above named work comprises the sixty lectures which Dr. Young delivered during his connection with the Royal Institution and includes also his optical and other memoirs as well as a very extended classified catalogue of publications in every leading department of science. His biographer in the "English Encyclopedia" remarks that Young's lectures embody a complete system of natural and mechanical philosophy, drawn from original sources, and are distinguished not only by extent of learning and accuracy of statement, but by the beauty and originality of the theoretical principles. One of these is the principle of interferences in the undulatory theory of light. "This discovery alone," says Sir John Herschel, "would have sufficed to have placed its author in the highest rank of scientific immortality, were even his other almost innumerable claims to such a distinction disregarded." The first reception, however, of Dr. Young's investigations of light was very unfavorable. The novel theory of undulation especially was attacked in the *Edinburgh Review*, and Dr. Young wrote a pamphlet in reply, of which only one copy was sold. He communicated frequently with the French philosopher Fresnel, who entertained views similar to his own on the nature of light. The undulatory theory is now generally received in place of the molecular or emanatory theory.

His review and treatment of the field of electrical and magnetic phenomena, as may be imagined from the foregoing, is very extensive, and as no justice could be done it

by making therefrom such extracts as would suitably come within the scope of the present "Chronological History," a portion only of the lecture treating of "Aqueous and Igneous Meteors" will here be given. Speaking of the Aurora Borealis, he says "that it is doubtful if its light may not be of an electrical nature. The phenomenon is certainly connected with the general cause of magnetism. The primitive beams of light are supposed to be at an elevation of at least 50 or 100 miles above the earth, and everywhere in a direction parallel to that of the dipping needle; but perhaps, although the substance is magnetical, the illumination, which renders it visible, may still be derived from the passage of electricity, at too great a distance to be discovered by any other test. . . . It is certainly in some measure a magnetical phenomenon; and if iron were the only substance capable of exhibiting magnetic effects, it would follow that some ferruginous particles must exist in the upper regions of the atmosphere. The light usually attending this magnetical meteor may possibly be derived from electricity, which may be the immediate cause of a change in the distribution of the magnetic fluid contained in the ferruginous vapors that are imagined to float in the air."

This assumption of ferruginous particles or vapors, remarks Prof. Robert Jameson, of the Edinburgh University, seems, however, purely gratuitous and imaginary; and as iron is not the only substance or matter capable of exhibiting magnetic effects, light itself being susceptible of polarization, the above hypothesis is, therefore, untenable even on the ground upon which it has been rested by its author. But it is, nevertheless, certain that the cause of this luminous meteor is intimately connected with magnetism and electricity; or, rather, as the magnetic is variously modified and effected by the electric power, with the phenomena of electromagnetism.[1]

A. D. 1808.——Pasley (Charles William), F. R. S., D. C. L., K. C. B., who was at the time aide-de-camp to Sir John Moore, and became Major General in 1841 and Lieutenant General in 1851, gives at pp. 205, 292, vol. xxix., and at p. 339, vol. xxxv., of Tilloch's *Philosophical Magazine*, a description of the original and improved methods of constructing his "polygrammatic telegraph."

The apparatus, as first devised by him between the years 1804 and 1807, consists of four posts, each bearing a pair of pivoted arms, which latter can be placed at different angles to indicate all desired numerals and letters. After he had seen the French semaphore during 1809 he improved his telegraph, employing but one post, upon which were three pairs of pivoted arms representing hundreds, tens and units.

In 1823 Pasley (then a Lieutenant Colonel Royal Engineers) issued a pamphlet entitled "Description of the Universal Telegraph for Day and Night Signals," wherein he announces the abandonment of the polygrammatic principle. For day service he employs an upright post with two movable arms attached to the top on a pivot. Each arm is capable of assuming seven different positions, besides the quiescent position called the *stop*, in which the arms are turned down and concealed by the post. To prevent signals being seen in reverse, another arm, called an *indicator*, is added to one side of the post. For night signals he places a central lamp at the top of the post, as well as a lamp at the end of each arm, and suspended a fourth lamp, as an indicator, upon a light crane projecting horizontally beyond the range of both movable arms. Motion to the arms was communicated by means of an endless chain passing over two pulleys. Up to this time the semaphores employed by the Admiralty had been constructed without provision being made for the display of night signals.

Pasley was the first to apply the heating power of the galvanic battery to a useful practical purpose. While engaged on the River Thames he was written to by Mr. Palmer (Alfred Smee, "Electro-Metallurgy," p. 297), who advised him to employ the galvanic battery instead of the long fuse then in common use, and as soon as he was made acquainted with the method of operating he at once adopted it and applied it effectively, during the year 1839, to the removal of the sunken hull of the Royal George, at Spithead.[2]

Following close upon Pasley's original telegraphic contrivance were several other methods of conveying intelligence at a distance, introduced during the year 1808, worthy of mention here.

The Chevalier A. N. Edelcrantz, Swedish savant, sent to the London Society of Arts a model of his apparatus, which is to be found minutely described in vol. xxvi., pp. 184–189, of the *Transactions* of that institution. A description of his earlier contrivances for the same purpose had already been published at Stockholm in the year 1796, and after being translated into French during 1803 had been noticed in William Nicholson's *Journal of Natural Philosophy* for 1803. The one he finally adopted in 1808 consisted of ten boards placed in three vertical ranks, the central one having four boards and the side ranks three boards each. By this arrangement 1,024 signals could be clearly shown, and it was possible, by observing the *order* in which the boards were exhibited, to make as many as 4,037,912 changes. He subsequently advised attaching lamps to the boards for night service. His method of working the boards, though a very complicated one, could be controlled by only one person, while the English systems required several men to hold the shutters during heavy weather. As it was, his method is said to have been in constant use for fully 12 years prior to 1808 on both sides the Baltic, and to have likewise served to transmit signals between Sweden and England.

Mr. Henry Ward, who had observed the difficulty with which the telegraph was worked at Blandford, in Dorsetshire, contrived the apparatus described in vol. xxvi., pp. 207, 208, of the London *Journal of the Society of Arts*. The grooved wheels which are fixed upon the axis of the shutters to receive the ropes by which they are turned have the grooved portion of the rim formed in two segments, which are so attached to the periphery of the wheels by steel springs that they fly off and remain a little distance off when there is no strain upon the ropes, although so soon as a rope is pulled its pressure forces the segments into close contact with the solid rim of the wheel. In the segments are two notches, which, when the shutters are in either of their required positions, engage with a fixed catch so soon as the strain on the ropes is relaxed, and so hold the shutters steady without any aid from the attendant. The pulling of a rope by drawing the segments close to the wheel relaxes the catch, and consequently enables the attendant to return any shutter to its original position.

Lieutenant Colonel John Macdonald, F. R. S., who was already favorably known by two Reports on the Diurnal

Dr. Thomas Young.

Variation of the Magnetic Needle observed at Fort Marlborough, Sumatra, and at St. Helena (*Philosophical Transactions* for 1796, p 340, and for 1798, p. 397, also "Eighth Encycl. Brit.," vol. xiv., p. 54), publishes (1808–1817) two treatises upon his "Terrestrial Telegraph," accompanied by an extensive "Telegraphic Dictionary." His contrivance consists of thirteen boards or shutters arranged, like those of Edelcrantz, in three vertical ranks representing hundreds, tens and units. Twelve of the boards are capable of producing 4,095 distinct combinations and the thirteenth or auxiliary board, which is mounted over the centre of the apparatus, doubles that number. A flag or vane is added to the hundred side to distinguish it in whatever direction it may be viewed, and a ball sliding upon the staff which supports it affords the means of again doubling the number, so that, on the whole, 16,380 distinct signals can be obtained. He subsequently adopted a modification of the contrivance introduced by Pasley in 1809, and also described a sort of a "Symbolic Telegraph," in which symbols like those of Dr. Hooke, but representing numerals instead of alphabetical characters, were dropped into open spaces representing hundreds, tens and units. He further suggested a useful flag telegraph for the navy and devised several schemes for night telegraphs both for land and sea, one of which latter consists of three sets of four lights each, with an additional or *director* light to each set, affording the same extensive powers as his large board or shutter telegraph.[3]

Major Charles Le Hardy communicates in 1808 to the London Society of Arts a novel contrivance consisting of a large framework with wire radiating bars, representing the numerals from 1 to 9, and four sets of other bars intersecting them so as to form four concentric polygons, which latter express units, tens, hundreds and thousands; thousands being shown by the innermost polygon. Attached to the centre of the apparatus are four slender arms, carrying four square boards, the lengths of these arms being such that the board of one may, during the revolution of the arm, traverse the polygon which represents thousands, that of another the polygon representing hundreds, etc By the addition of two other boards at the upper corners, one of which denotes 10,000 and the other 20,000, or, when displayed together, 30,000, the total range of the telegraph is from 1 to 39,999.[4]

In the twenty-seventh volume of the *Transactions* of the London Society of Arts will be found the telegraphic devices of Mr. Knight Spencer and of Lieutenant Spratt, while the thirty-third volume contains a description of the contrivance of Mr. Alexander Law, intended for service on both sea and land. There, it may be said, are the only telegraphic methods worthy of note introduced up to the time when the English Admiralty adopted the system proposed by Sir Home Popham in 1816. The "anthropotelegraph" of Mr. Knight Spencer, though laid before the Society of Arts in 1808, had been used as early as 1805. It consisted merely of two circular discs of wicker work, painted white with a black circle in the centre, to be held in different positions with respect to each other. The device of Lieutenant Spratt was more simple still, for it consisted only in holding a kerchief in various positions, yet, simple as it was, it served as a means of communication between vessels before the battle of Trafalgar, and it was also successfully used to converse between Spithead and the ramparts at Portsmouth, etc.[5]

A. D. 1808.——Callender—Calendar (Elisha), of Boston, Mass., obtains, on Oct. 3, 1808, for his lightning rod, an American patent, which latter is the first one in the line of electricity issued by the United States.[6]

A. D. 1808.——Bucholz (Christoph—Christian—Friedrich), distinguished German chemist, receives his diploma as a physician at Rinteln, prior to graduating at the Erfurt University, and publishes "Ueber die Chimischen . . . metallen," giving a description of the chain bearing his name. The latter was the outcome of experiments which were made by him to prove that the electricity in the pile results from the oxidation of one of the metals, and during which he sought to establish a comparison between the quantity of electricity obtained and the amount of oxygen absorbed by the one metal.[7]

A. D. 1808. ——Amoretti (Carlo), Italian naturalist, who was allowed 1772 to withdraw from the order of St. Augustine that he might devote himself exclusively to scientific researches, gives, in his "Della rabdomanzia ossia elettrometria," a complete history of the divining rod, and treats also therein of animal magnetism, etc.; his investigations of the electric polarity of precious stones showing, among the results, that the diamond, the garnet and the amethyst are — E while the sapphire is + E.[8]

A. D. 1808.——Lebouvier-Desmortiers (Urban René Thomas), French writer, who had called attention to the danger attending the bodily application of the galvanic fluid, through the *Journal de Physique* of 1801 (p. 467), transmits another mémoire to the same publication upon an improved electrical (*briquet*) tinder box.

The cylinder, which had previously been made of copper, he finally succeeded in constructing of glass in the manner illustrated by Delaunay at plate ix., fig. 105, of his "Manuel, etc.," Paris, 1809. With the new contrivance he was enabled to exert considerable force upon the piston, and it was generally necessary to push the latter suddenly in order to so compress the air as to light the (*amadou*) spunk attached to the lower portion of the tube or cylinder.[9]

A. D. 1809.——Krafft (Wolfgang Ludwig), professor of experimental philosophy in the Imperial Academy of Sciences of St. Petersburg, is the author of "Uber ein hypothet . . .," wherein is given the result of his investigations of the phenomena of terrestrial magnetism.

Comparing Biot's examination of the dip observations previously made by Humboldt, Krafft simplified the former's conclusions, showing that if we measure the latitude

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[1] See Young's Catalogue for "Aurora Borealis" and "Terrestrial Magnetism" ("Lectures," London, 1807, vol. ii., pp. 440–443, 488–490), "Journal Roy. Inst.," vol. i.; Dr. George Peacock's "Life of Thomas Young;" also "Miscellaneous Works of T. Young." London, 1855; "Memoirs of the Life of Thos. Young," London, 1831; also vol. xiii. of John Leitch's "Hieroglyphical Essays and Correspondence," all of which contain every contribution made by the scientist to the *Phil. Trans.*, as well as many other important articles communicated by him to other scientific publications of his time; "Eloge Historique du Dr. Thomas Young," par Mr. Arago, in *Mém. de l'Acad. Roy. des Sc.*, etc., tome xiii., p. 57; *Quarterly Review* for April, 1814; Tyndall, "Heat as a Mode of Motion," 1873, pp. 267, 268; *Annales de Chimie*, Feb., 1815; Whewell, "History of the Inductive Sciences," 1859, vol. ii., pp. 92, 96, 106, 111–118.

[2] See Sturgeon's "Scientific Researches," Bury, 1850, p. 174; Knight's "Mech. Dict.," vol. i, p. 784; also "Documents relatifs à l'emploi de l'Electricité, etc.," Paris, 1841, taken from the *United Service Journal* and the "Militaire Spectateur Hollandais."

[3] See, also, *Phil. Mag.*, vols. lvii., pp. 88-93, and lviii., pp. 99-103,

[4] See *Philosophical Magazine*, vol. xxxiii., p. 313.

[5] For Mr. Knight Spencer's other papers, see the *Philosophical Magazine*, vols. xxxvi., p. 321, and xl., p. 206, and, for different methods of telegraphing, see Mr. Macdonald's "Treatise," published in 1817, as well as, more particularly, vols. xxvi., xxxiv., xxxv., xxxvi. of the *Transactions of the Society of Arts;* likewise Rohde's "Système complet de Signaux. . .," published 1835.

[6] See H. L. Ellsworth's "Digest of Patents," Washington, 1840, p. 234; Edmund Burke, "A List of Patents," Washington, 1847, p. 185; "List of United States Patents," Washington, 1872, p. 67.

[7] See "Biographie Universelle," Bruxelles, 1843-1847, vol. iii., p. 227; A. F. Gehlen, *Jour. für Chem. und Phys.*, vol. v.; L. Figuier, "Exp. et Hist.," Paris, 1857, vol. iv., p. 426; "La Grande Encyclopédie," vol. viii., p. 315, and also, the letter of J. B. Van Mons to Bucholz, Brussels, 1810.

[8] For a further account of the *Virgula Divina*, or divining rod (*Baguette divinatoire*), see the "Gentlemen's Magazine" for 1751, vol. xxi., also the notes at foot of pp. 91–106 of Baron Karl Von Reichenbach's "Physico-Physiologicæ Researches," translated by Dr. John Ashburner, London, 1851. In the latter reference is made to Pierre La Lorrain de Vallemont's "La Physique Occulte, etc." (1693), to a work written by Count J. de Tristan, to the "Mémoire, etc.," of Tardy de Montravel (1781) and to Pierre Thouvenel's "Memoires, etc.," the last named bearing the Paris-London imprint of 1781–1784, and attempting to show relations existing between the rod and electricity and magnetism. Allusion is likewise made in the aforenamed work to the translation by Dr. Hutton (1803) of Jean Etienne Montucla's (1778) improvement of Jacques Ozanam's "Récréations Mathématiques et Physiques," originally built upon Leurechon's "Récréations Mathématiques," and first published in Paris during the year 1724. Besides the above, reference should be had to the lecture of Prof. Rossiter W. Raymond before the Philadelphia Electrical Exhibition of 1884, and to the articles in Paris *Cosmos* of Jan. 3, 1891, which alludes to the works of P. Lebrun (1702), Albert Fortis (1802), Dr. Charpignon (1848), Abbé Chevalier (1855), and M. E. Chevreul "De la baguette . . ." (1854). Consult, also, Eusebe Salverte, "The Philosophy of Magic," vol. ii., chap. xi., speaking of Pryce's "Mineralogia Cambriensis" (1778); T. Kirchmaier, "De Virgula divinatrice"; F. Soave (*Opus Scelti*, iii., 253), 1780; F. M. Stella (*Opus. Scelti*, xiii., 427), 1790; G. B. San Martino (*Opus. Scelti*, xvii., 243), 1794; L. Sementini "Pensieri e Sperimenti . . ." 1811; A. M. Vassalli-Eandi (*Opus. Scelti*. xix., 215, etc.); Kieser, *Archiv.*, vol. iv., p. 62—at vol. i., p. 265, of Blavatsky's "Isis Unveiled;" "Biographie Générale," vol. ii., pp. 290, 291; "Roy. Soc. Catal. of Sc Papers," vol. i., p. 58.

[9] See his "Examen des principaux systèmes . . . ," Paris, 1813; J. C. Poggendorff, *Biogr. Liter. Hand. . . .*," vol. i, p. 1,399; Larousse, *Dict. Univ.*, vol. x., p. 290; *Journal de Médicine*, vol. xxvi., pp. 298-303; *Catal. Sc. Pap. Roy. Soc.*, vol. iii., p. 910; C. H. Wilkinson, Elements of Galvanism," London, 1804, vol. i., p. 461; V. Delaunay, "Manuel de l'Electricité," Paris, 1809, pp. 151–153; Detienne "De l'électricité de pression," *Journal de Physique*, 1777, vol. ix.

from the magnetic equator, the tangent of the dip is double the tangent of such latitude; or, as he expressed it, "If we suppose a circle circumscribed about the earth, having the two extremities of the magnetic axis for its poles, and if we consider this circle as a magnetic equator, the tangent of the dip of the needle, in any magnetic latitude, will be equal to double the tangent of this latitude."

This has been illustrated by experiments of Mr. Barlow on magnetized iron balls acting upon small needles at the surfaces, and Mr. Biot, upon re-examining his previous formula, found that it was reducible to the above enunciated law.

Krafft gave a complete theory of the electrophorus in the first part of the 1778 "Acta Acad. Petrop.," which latter also contains his experiments with Canton's phosphorus and his observations on the aurora of Feb. 6–17 of the same year. The results of many of his other investigations are to be found in part ii. of the same work as well as in vols. xv. xvii. and xix. of the "Novi Commentarii Academiæ Petropolitanæ."

A New Rheostat.*

BY CHARLES E. CARPENTER.

It is a well known fact that an insulated wire suspended in the air will carry a given amount of current at a lower temperature than the same wire without this covering of ns ulation under the same conditions. This is obviously due to the fact that while the cross-section of both conductors is the same, the one which is insulated has a much larger radiating surface than the bare wire, and therefore dissipates the heat conducted through the insulation more rapidly. Suppose, for convenience of illustration, we conceive a conductor to be first covered with some insulating substance, and then inclosed within a metallic tube so that its insulated surface shall fit perfectly within and against the inside surface of the tube, as shown in section in Fig. 1. We thus have a comparatively small conductor with a largely increased radiating surface, and the insulation between the two metallic bodies does not materially obstruct the flux of heat from the conductor to the outside metallic shell.

The better the conduction for heat is made, the less will be the difference of temperature between the wire and the outside radiating surface plate, and it follows that the larger the surface of the radiating plates which are closely impressed upon the conductor, the larger will be the current-carrying capacity of the latter.

The principle upon which the new and improved rheostat

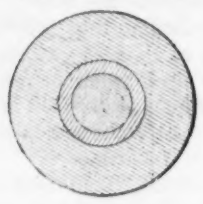
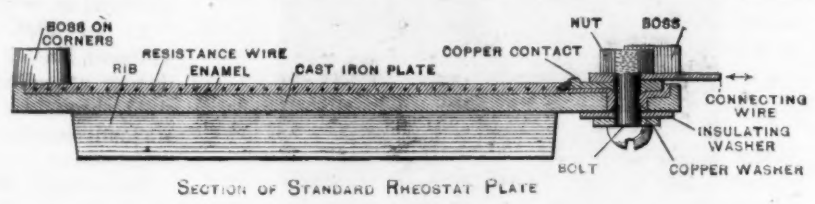


Fig. 1.



Section of Standard Rheostat Plate

Fig. 2.

herein described is based, is that a resistance wire of small cross-section is used, but a large radiating capacity is secured by placing the wire in such relations to a metal plate as to practically increase its radiating surface to a very great extent.

The results of experiments suggested a modified form of construction, one in which the resistance would be entirely covered by a medium which would protect the wire from oxidation and yet act as a good insulator of electricity and a good conductor of heat, and which will permanently attach the wire to, but insulate it from, a radiating plate. A special enamel was finally found by the writer to be suitable for this purpose. A section of this construction is shown in Fig. 2.

The injurious effect of linear expansion of the resistance wire, due to heat, is avoided in this method by the "reflexed" or "zig-zag" form in which the wire is bent, as shown in Fig. 3, and it has been demonstrated by experience that this linear expansion is thereby so distributed as not to injure or crack off the enamel in practice.

On this principle, since we are able to greatly reduce the cross-section of the conductor, it follows that its length is also proportionately shortened for any required resistance, and no consideration of the mechanical strength of the wire enters into this construction, since it is so perfectly confined and supported on all sides.

Practice has demonstrated that 20 watts of electrical energy may be dissipated continuously to each square inch of resistance surface without injury to the apparatus. However, on account of the excessive temperature of the plate used in close proximity to the other materials, it is not practicable to dissipate over 8 or 10 watts to the square inch in continuous service.

By placing one surface of the plate in contact with water, so that its heat is dissipated in this manner, we are able to continuously dissipate about 25 watts to the square inch. From this it will be seen that by means of water we are able to increase the capacity of a certain plate to about three times that of the same plate dissipating its heat directly into the atmosphere, or we may decrease the size of the plate to one-third for the same capacity where water is used.

In many applications, especially in railway work, apparatus is often subjected to a load far beyond its rated capacity. Rheostat plates for such service are made with narrow ribs, between which the resistance wire and enamel are placed. It is found that by means of these ribs the safe carrying capacity of a wire is greatly increased, while the ribs serve also to protect the insulation and wires from mechanical injury.

Connection to the resistance wire is made by means of a sheet copper contact strip, one portion of which is folded back upon itself, and after inserting a portion of the wire this sheet copper is crushed about it. The joint so formed cannot oxidize, since it is completely sealed by the enamel fused about it.

To divide the resistance so formed into steps, it is only necessary to place contacts for connection to the resistance wire at convenient points where the loops approach the edge of the plate, as at *a*, and so on, in Fig. 3. This particular way of locating the connecting points on one side of the plate is especially convenient in using these plates with small motors, where only a few steps or divisions of the resistance are required. Another arrangement is required in a plate of low resistance and high ampère capacity. In this case several coils are placed in parallel and connected to a common contact piece.

Fig. 4.

A very simple and complete rheostat is made by placing the switch contacts and lever, properly insulated, directly upon the radiating plate, on the surface opposite the resistance face. With this arrangement, as shown in Fig. 4, a rheostat is obtained which is no larger than the switch parts alone of existing rheostats.

This form of rheostat, by reason of its compactness, is well adapted for use with arc lamps on constant potential circuits. In this application the resistance plate may be attached directly to the outside of the casing, leaving just sufficient space between the casing and the plate for ventilation. A valuable feature of this rheostat in this application is that it will endure exposure to the weather while in use.

It is evident that numerous modifications of this general design may easily be made to adapt the apparatus to the requirements of practice.

The following facts are true regarding this form of rheostat:

1. It is fireproof, as no combustible material enters into its construction, and it can never be submitted in normal use to a temperature so high as that to which it is subjected in the process of manufacture.

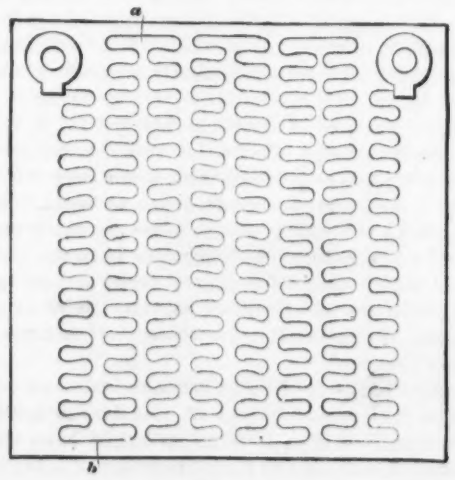


Fig. 3.

2. It is durable, since the resistance wires cannot deteriorate from oxidation, electrolysis, etc.

3. It is compact, as it requires less than 5 per cent. of the cubic space required by the ordinary coiled wire rheostat of the same capacity.

4. It is simple, the three necessary elements, resistance wire, insulation and radiating surface plate, being fused into one integral mass.

5. It is cheap, for a certain resistance and carrying capacity can be obtained by the use of a wire whose cross-section and length will both be but one-tenth of that required for a wire used in the air. That is, the total weight of wire, and hence the cost of the same, will be but one per cent. of that usually required.

6. It is unaffected by heat, cold, acids, alkalies, oils and other chemicals, and for this reason is especially adapted for use in mines, breweries, marine vessels, etc., where chemical action rapidly destroys ordinary insulators. It is even practicable to operate these plates submerged in flowing water, in case it is desirable to carry off the heat in this way.

Another and important application of this method of converting electric energy into heat in a compact form is for the operation of various heating devices.

The requirements of a commercially successful electric heating device are:

1. The concentration upon the working surface of the apparatus of practically all of the heat produced in the resistance, thus preventing as far as possible the dissipation of heat by radiation or conduction to other bodies or parts than those it is required to heat.

2. The ability to rapidly supply a large amount of heat energy from the resistance to the working surface, through a medium having a high conductivity for heat, thus keeping the working surface at the proper temperature even when a large amount of heat is rapidly drawn from it.

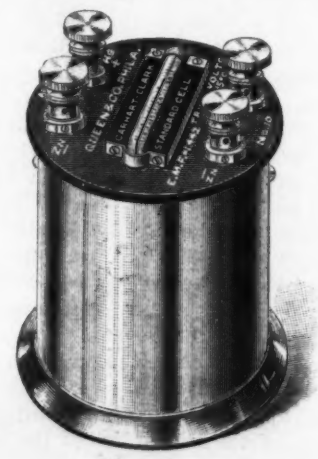
3. The protection of the resistance wire from deterioration by chemical and electrical action, so that its life shall be indefinitely prolonged.

All the above requirements are fulfilled in this device.

Carhart-Clark Standard Cells.

The accompanying illustration shows a new form of the Carhart-Clark cell with thermometer permanently attached. The Carhart-Clark standard cell is the result of several years' study devoted to the subject of standard cells by H. S. Carhart, professor of physics and electrical engineering at the University of Michigan. Recognizing the fact that all known forms of standard cells had but small endurance, and could not in the least stand the jars and strains of transportation without permanently destroying both accuracy and constancy, Prof. Carhart, about five years ago, started out on the basis of Lord Rayleigh's experiments in standard cells, with a view to making a cell having no local action, perfectly sealed, giving a uniform and constant E. M. F. for all time, and which should not be injured by transportation.

After over two years' study and trial, Prof. Carhart, in the early part of 1889, completely solved the problem. The Clark cell, as is well known, is composed of zinc and mercury as electrodes, and mercurous sulphate and zinc sulphate as salts. Great difficulty has always been found in securing the ingredients in a pure state, the smallest



Standard Cell.

amount of foreign matter being sufficient to destroy the reliability of the cell. Another great trouble has been that in transportation the mercury would be so shaken through the other salts as often to cause a short circuit. The first of these difficulties Prof. Carhart has overcome by making his own chemicals, the second by the use of a special device, so that any short circuit in transportation is practically impossible.

One of the chief points of the Carhart-Clark cell is its very low temperature coefficient, which has been reduced from 0.08 % per degree C. to about 0.03, or from 0.00077 to 0.00039, thus making for all practical purposes the temperature change inappreciable. Each cell has inside of its mounting an extra graphite resistance of about 10,000 ohms, so that no particular injury will result should it be accidentally short circuited for a short time. The cells proper are prepared by Prof. Carhart, at his laboratory, in the University of Michigan, and are furnished with his own personal certificate of accuracy, which also states the exact E. M. F. at 15 degrees C., and the temperature coefficient of the cell.

Queen & Co., Philadelphia, prepare the mountings for these cells, and are placing them upon the market.

* Abtract of a paper read at the meeting of the American Institute of Electrical Engineers.

The "Multiple" Wire Table—for Copper Wires.*

BY EDWIN PLACE.

The table is divided into four parts by heavy lines at right angles. The upper left hand portion gives the sizes in B. & S. gauge from No. 4-0 to No. 20 and their diameters in mils; opposite these, currents in ampères. The lower left hand portion gives the distances away for double lines and the corresponding lengths of wire; opposite these to the right, volts loss. The heavy broken line through the ampères shows the approximate limit to the carrying capacity of different wires.

To find the size of wire of given length to give a certain loss in volts with a given current.—Opposite the length or distance select the number showing the loss in volts. In the same column as this last in the ampère table find the current to be carried. Opposite to this will be found the required gauge number.

The quotient of any number opposite the length, divided by the number in the same column opposite the size, is the resistance in ohms of that wire.

To find the resistance of two or more wires joined in parallel.—Select from the table any convenient pair of numbers for each wire, each pair showing the resistance of that wire. Multiply each volt thus chosen by such factors as shall give the same product for all, this product to be used as dividend. Multiply the ampères, each by that factor used with the corresponding volts, and use the sum of these several products as divisor. The quotient is the combined resistance.

When the lengths are the same, select any number opposite it for dividend and use the sum of the numbers in the same column opposite the sizes for divisor.

To find the resistance of several wires joined in series.—Apply the above rule with the words "volts" and "ampères," "dividend" and "divisor," "length" and "size" interchanged.

EXAMPLES ILLUSTRATING THE USE OF THE TABLE.

In this table the numbers on the right of the heavy line in the same horizontal row bear the same ratio to one another as the numbers at the head of their respective columns. In any column of ampéres the numbers are in the ratio of the cross sections of the wires found opposite; and in the volts the numbers are in the ratio of the lengths or distances opposite.

To find the size of wire necessary to feed 15 incandescent lamps in parallel, each taking one ampère, placed 60 feet from the mains, allowing a loss of 2 volts.—On a line with 60 in column (8) is found the number 2.01 representing the loss in volts. Above in the ampère table, in the same column, is found 16.1, the nearest ampères. To the left of this, in the same row, will be found 10, the gauge number sought.

The resistance of this wire equals $\frac{2.01}{16.1} = .125$ ohms.

To find the resistance of 80 feet of No. 20 and 200 feet of No. 12 joined in parallel.—For the first wire the number 1.00 and 1.20 column (6) are chosen whose ratio $\frac{1.00}{1.20}$ equals its resistance, and for the second from column (3) the numbers 1.25 and 3.79, whose ratio $\frac{1.25}{3.79}$ is its resistance. Reducing these fractions to a common numerator by multiplying the terms of the first by 1.25 and adding the denominators, we have $\frac{1.25}{1.50 + 3.79} = \frac{1.25}{5.29} = .236$ ohms for the result.

To find the resistance in parallel of 100 feet of each of Nos. 14, 18 and 20.—Take any number opposite 100, as .834 in column (4), and divide it by the sum of .790 + 1.26 + 3.18 found in the same column opposite the sizes. The quotient is the resistance, thus $\frac{.834}{5.13} = .162$ ohms.

To find the resistance in series of 280 feet of No. 16 and 160 feet of No. 19.—In column (2) we find $\frac{1.17}{1.0}$ as the resistance of the first; and in column (7), $\frac{2.34}{1.70}$ for the resistance of the second. Multiplying the terms of the first by 1.7 we get $\frac{1.99}{170}$. Hence the resistance is $\frac{1.99 + 2.34}{1.70} = \frac{4.33}{1.70} = 2.55$ ohms.

Diam. in Mils.	B. & S. Gauge.	1	2	3	4	5	6	7	8	9	10
		Ampères.									
460	0000	41	82	123	164	205	246	287	328	369	410
409.6	000	32.5	65	97.5	130	163	195	227	260	292	325
364.8	00	25.8	51.5	77.3	103	129	155	179	206	232	258
324.9	0	20.4	40.9	61.3	81.7	102	123	143	164	184	204
289.3	1	16.2	32.3	48.5	64.7	80.8	97	113	129	145	162
257.6	2	12.9	25.7	38.6	51.4	64.3	77.1	89.9	103	116	129
229.4	3	10.2	20.4	30.6	40.7	50.9	61.1	71.3	81.5	91 7	102
204.3	4	8.08	16.2	24.3	32.3	40.4	48.5	56.6	64.6	72.7	80.8
181.9	5	6.41	12.8	19.2	25.6	32.1	38.5	44.9	51.2	57.6	64.1
162	6	5.08	10.2	15.3	20.3	25.4	30.5	35.6	40.6	45 7	50.8
144.3	7	4.03	8.06	12.1	16.1	20.2	24.2	28.2	32.2	36.3	40.3
128.5	8	3.20	6.39	9.59	12.8	16.0	19.2	22.4	25.6	38.7	32.0
114.4	9	2.53	5.07	7.61	10.1	12.7	15.2	19.8	20.3	22.8	25.4
101.9	10	2.01	4.02	6.03	8.04	10.1	12.1	14.1	16.1	18.1	20.1
90.7	11	1.59	3 19	4.78	6.38	7.97	9.56	11.2	12.8	11.4	15.9
80.8	12	1.26	2.53	3.79	5.06	6 32	7.58	8.85	10.1	11 4	12.6
71.9	13	1.00	2.00	3.01	4.01	5.01	6.01	7.01	8.02	9.2	10.0
64.1	14	.794	1 59	2 38	3.18	3.97	4.76	5 56	6.35	7.15	7.94
57.1	15	.635	1.27	1.81	2.54	3.17	3.81	4.44	5.08	5.72	6.35
50.8	16	.5	1.0	1 5	2.0	2.5	3.0	3.5	4.0	4.5	5.06
45.2	17	.396	.793	1.19	1.59	1.98	2.40	2.78	3.17	3.57	3.96
40.3	18	.315	.629	.944	1.26	1.57	1.89	2.20	2.51	2.83	3.15
35.4	19	.243	.485	.727	.969	1.2	1.31	1.70	1.94	2.18	2.43
32	20	.198	.395	.593	.790	.988	1.20	1.28	1.58	1.79	1.98
50	10	.042	.084	.125	.167	.269	.251	.292	.334	.375	.418
40	20	.084	.177	.251	.334	.418	.501	.584	.668	.752	.836
60	30	.125	.250	.376	.501	.626	.752	.876	1 00	1.13	1 25
80	40	.167	.354	.501	.668	.836	1.00	1 17	1.34	1.50	1.67
100	50	.209	.418	.627	.834	1.04	1.25	1.46	1.67	1.88	2.09
120	60	.251	.502	.752	1.00	1.25	1 50	1.76	2.01	2.26	2.51
160	80	.334	.669	1.00	1.34	1.67	2.01	2.34	2.67	3.01	3.34
200	100	.418	.836	1.25	1.67	2.09	2.50	2.92	3.34	3.75	4.18
240	120	.502	1.00	1.51	2.01	2.50	3.01	3.51	4.01	4.51	5.02
280	140	.585	1.17	1.76	2.34	2.43	3.51	4.10	4 68	5.27	5.85
320	160	.669	1.34	2.01	2 67	3.34	4.01	4.68	5.34	6.02	6.69
360	180	.752	1.54	2.26	3.01	3.76	4.51	5.27	6.02	6 67	7 72
400	200	.836	1.67	2.50	3.34	4.18	5.00	5.84	6.68	7.52	8 36
5 0	250	1.05	2 09	3 13	4 18	5.22	6.27	7.31	8.36	9.40	10.5
600	300	1.25	2.50	3.75	5.00	6.27	7.52	8.78	10.0	11.3	12.5
700	350	1.46	2.92	4.39	5.85	7.31	8.77	10.2	11.7	13.2	14.6
800	400	1.67	3.34	5 01	6.69	8.36	10.0	11.7	13.4	15.0	16.7
900	450	1.88	3.76	5.64	7.52	9.40	11.2	13.2	15.0	16 9	18.8
1,000	500	2.09	4.18	6.27	8.36	10.4	12.5	14.6	16.7	18.8	20.9
Length in feet.	Dist. in feet.	Volts.									

* Copyright, 1892, by the author.

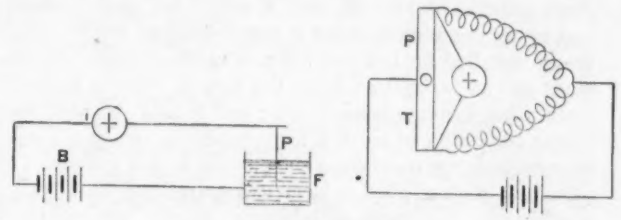
Cable Relays.*

BY WALTER JUDD.

I have been much interested in the recent communications to the electrical journals on the subject of cable relays. The cable relay is an instrument which has been, I suppose, the dream of cable managers and electricians for years, and one that has seriously occupied the minds of many of us. It may be interesting to those who have experimented in this direction if I shortly recount the experiments made in Hong Kong during the last five years.

The first idea that occurs to any experimenter is naturally a relay with fixed contacts; but, as Mr. Cuttriss says, the "sticktion" is fatal to success. In 1887 I endeavored to vary the resistance in a local circuit by including in it a high resistance plunger dipping into a conducting solution, the resistance varying with the length of plunger out of the fluid, somewhat as shown in Fig. 1, *P* being the plunger raised and lowered by the recorder coil, *I* the local instrument, *B* battery, *F* the conducting fluid. I tried porous earthenware, carbon rods of high resistance, also compounds of Portland cement and plaster of Paris with plumbago and powdered carbon, but found that a thin strip of ordinary paper gave the best results. I then tried thin elastic threads, coated with powdered carbon or plumbago, obtaining the variation of resistance by the amount of extension produced by the movement of the recorder coil. Microphonic contacts of two carbon points were also tried, but given up as impracticable, the range between perfect contact and infinity being too small and variable. All the above methods were tried in 1887 and 1888, but it was found that the principle sketched above involved a current being always in the local instrument, the movement being obtained by increments and decrements of the current passing, rendering adjustment and fixed zero difficult to maintain. In 1889, in consequence of this difficulty, I adopted the bridge method, and from that date to this experiments have been carried out. I reverted to the plumbagoed elastic threads, but was unable to obtain good contacts, and therefore returned to the water resistance.

The experiments have all been carried out with an ordinary recorder, the aluminium siphon cradle being used as the pointer to be moved in the trough. At first the connections were thus (Fig. 2): The current from the battery all passed into the water trough *T* by the plunger or pointer *P*, and the current density, owing to the small surface, about four millimetres, caused immediate bubbling. To obviate this, the current was commuted into an alternating current, and redressed by another commutator in the galvanometer circuit, thus (Fig. 3): The two commutators *C C* were mounted, of course, on the same shaft, and it was found that, owing to the counter electromotive force set up in the water trough *T*, there was a slight lag, and the commutator brushes had to be adjusted accordingly. The alternating current certainly diminished the trouble due to

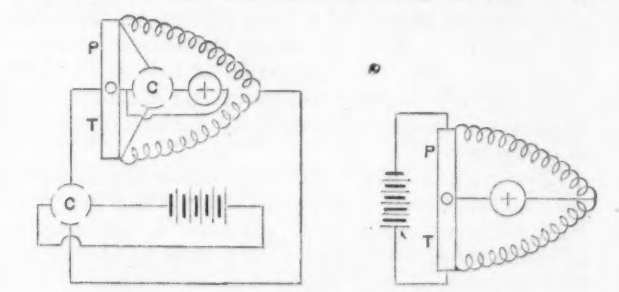


FIGS. 1 AND 2.

gas bubbling, but it was found still to occur when the current had passed for some considerable time, and by gathering round the pointer *P* the bubbles held it so fast as to almost destroy its movement. The next change was to make the connections so that the pointer only had to carry the current in the galvanometer circuit (Fig. 4). This effected a great improvement, and certainly reduced the bubbling.

We then dispensed with the commutator and made a trough with large electrodes. In plan the trough was as in Fig. 5. *A* and *B* are circular holes, about ¾ inch in diameter, in a slab of ebonite, joined by a narrow trough. *A* and *B* are lined with lead, and connected to suitable terminals. The whole system is then filled with liquid, and thus forms two arms of a bridge. With a considerable direct current we found that the bubbling became apparent after several hours, and evidently either larger electrodes or some depolarizing compound was required. This it is difficult to use without at the same time making the liquid too conducting.

Matters were in this stage when we heard of Mr. Cuttriss' charming plan of spiral carbons. If this works, then most undoubtedly in my opinion it is the best. Electrolytes are always variable, and they also evaporate, while carbon, once adjusted, should remain very fairly constant. I con-



FIGS. 3 AND 4.

gratulate Mr. Cuttriss on his ingenious device, and trust that now attention is called to the subject the cable relay will soon be *un fait accompli*. The double differential system proposed by Mr. Raymond Barker can easily be applied to the carbon spring method, and will, of course, make it more sensitive.

Now one word as to its use when perfected. I think that it is hopeless to relay from one cable to another unless the cables are very short. For long cables I do not believe in the possibility of obtaining impulses sufficiently clear and distinct to operate any dead-beat relay, which would be required to actuate signaling levers. If it could be done, the apparatus would be so delicate and complicated that it could never be left to itself, and if an experienced man is to be in attendance, it is far better to let him be the translator, as in Mr. Smith's human relay method. I have all along looked to a relay as a means of doing away with the siphon and the friction against the paper, which takes place at every vibration, and so obtaining a sharper and more defined movement reproducible upon a simpler and

FIG. 5.

ess sensitive local instrument. Any one who will watch the movement of the siphon cradle when the siphon is off cannot fail to see the gain in definition. This applies only, or principally, to long cables, and I imagine that a gain in speed of 10 to 20 per cent. can be realized by a good relay—an enormous advantage in every way. In common with all who are interested in cables, I wish every success to the ingenious inventors who have brought this much desired improvement within the sphere of practical electrics.

* *London Electrician.*

Electrical Transmission of Power for Cotton Mills.*

BY C. J. H. WOODBURY.

Electric motors are now used for hundreds of purposes, but this paper will be confined to references to their uses in cotton mills.

Electric motors are frequently proportioned to use low pressure currents of electricity, like those employed for direct incandescent lighting. There are many places where motors can be operated by wires from any of the direct incandescent lighting dynamos, but if the power required for the motor is more than about one fifth that required to keep the whole number of lamps lighted, the lights will rise and fall in brilliancy, like those in an electric car when the motor stops and starts, and the lighting service is unsatisfactory and the life of the lamps diminished.

The problem is one which must be worked out in each case; sometimes when a small motor is required for use at short intervals during the day, it might be more economical to use conductors from a large dynamo which is already installed for lighting the mill at other times. If constant service is required from the motor, then a separate generating dynamo is advisable; and it may be said that in the generality of work it is preferable to put in a generator suitable for furnishing the current to the motors. The principle holds as good in electric apparatus as in all other machinery, that more satisfactory results are obtained when there is no attempt made to require a more varied service from any machine than it is fully adequate to furnish.

It is generally advisable to use electricity for the transmission of power at a much higher pressure than that found best suited to incandescent lamps, because there is a great saving in copper for conductors and a lesser proportion of the electricity absorbed by the resistance of the wires. The current of 500 volts pressure used for the trolley system of street car propulsion is not capable of inflicting serious injury on mankind, although frequently fatal to horses.

Before deciding to install an electric power plant for a service outside of what is already fixed by precedent, expense, delays and disappointments may be avoided by deciding how much you are willing to experiment; and, secondly, how much the party doing the work must experiment before the whole installation is in a practical operating condition.

The fact should not be lost sight of that electricity is merely a substitute for other methods of transmission of power. It has its losses at every step in the course, comparable with those of the wear and tear and friction of shafting and belting. Like them, it also costs money, requires attendance and wears out. It does not in any detail give something for nothing, but the results in comparison with other mechanical means of the transmission of power are merely the addition of a lot of differences. Sometimes these differences are on one side of the account and sometimes on the other. An installation of motors in one instance may be extremely economical and in another highly expensive in comparison to ordinary methods of transmission of power.

Electric motors, like water wheels or steam engines, have their highest efficiency at a point near to their full proper load, and on either side their efficiency in the percentage of electricity converted into work is diminished. The practical operation of some motors has been improved by the use of fly-wheels. In its application for mill service, the most simple uses are those requiring a variable speed and direction, largely on account of causes outside of the electrical conditions in the construction of such motors. It is especially advantageous for elevators in storehouses or other buildings not requiring power elsewhere. A motor can be attached to any elevator machinery operated by a belt, and the elevator can be managed in the same manner as before, so that the men have nothing either to learn or to forget. The first motor used for operating an elevator in a cotton mill storehouse was placed in that service in 1882, and is in as good working condition to-day. Another use having a larger field is in its application for railways in mill yards and buildings. The Salmon Falls Manufacturing Company has 2,100 feet of track in the mill yard, and is operating a trolley system of cars to move all their cotton, supplies, cloth and coal with two men, thereby dispensing with the services of a team and three men all of the time, and a fourth man a part of the time. The car makes an average speed of 600 feet per minute, and is always ready for service whenever the water wheel is running. Other mills use electric railroads from the cloth room to the storehouse with even greater reduction in cost of moving the load.

There are two systems of overhead trolley propulsion; the ordinary single overhead wire with the current returning through the wheels to the rails, and thence back through the earth to the dynamo, is the simplest, and the only one that has a practical system of switches in the wires overhead. This system contains a serious objection in the electric sparks constantly occurring in the contact of the wheels with the rails, and liable to ignite any combustible substance there, and, therefore, could not be safely used inside of mills. For inside use it is necessary to use the double overhead wire system, by which the circuit is made between the two wires without using the rails as conductors. In either case the overhead wires should be thoroughly protected by guard wires whenever there is a possibility of telephone or other wires falling upon them.

Electricity is fulfilling a most useful purpose in operating traveling cranes, and the few storehouses in mills which are provided with traveling cranes use them at such infrequent intervals that it is probable that hand power is still the cheapest method of operation, but for erecting shops and other places where constant service is required, electricity affords great advantages for working such cranes.

Motors have been applied to calico printing machines with great success. The absence of heat, small amount of space, little momentum of the revolving parts, and the control by which the machine can be uniformly moved in either direction at any desired speed, are all advantages of the highest practical value.

Other classes of work require that the motor should revolve at as uniform speed as can be obtained by a water-wheel, or better if possible. Motors will revolve at a constant speed if furnished with a current of uniform pressure. A compound generator will produce a current at a uniform pressure with variations in the load or quantity of current required by the motors; and it will also to some extent compensate for slight variations in the speed at which it is driven. Therefore it may be said that the speed of an electric motor may be more uniform than that of the water wheel or engine from which it derives the power which it gives forth.

A variation in lights is not a direct measure of variation in a dynamo, because a change of one per cent. in the pressure of the electricity in an incandescent lighting system would cause a variation of several per cent. in the amount of light from the incandescent lamps.

The class of service for the distribution of power throughout a mill as a substitute for belt or rope transmission has not been tried in cotton mills, but there are many cases where it has been tried in machine shops and yielded excellent results. The amount of power required in cotton mills is so much greater than in machine shops that the subdivision should be to a smaller unit than a whole room in a large mill. I am convinced that such a distribution of power is mechanically feasible, but will it pay to do so when motors and generators each cost nearly or quite $40 per horse power, or including wire and foundations over $100 for every horse power transmitted?

Another class of applications consists in distributing the electricity from a central station in a mill yard to the various buildings. The most complete plant of this kind is at the Edison Works at Schenectady, where 1,700 h. p. is electrically distributed to numerous shops situated at various places on a tract some twenty acres in extent. The Thomson-Houston Works at Lynn have an extensive electrical distribution of power in their present works, and will have a larger power plant when their new works are completed.

At the Cumberland Mills in Maine 260 h. p. is transmitted over a mile by the Mather electric system, and motors are used to drive paper machinery, giving from poorly governed water wheels a sufficiently steady motion for calenders, but the compensation by the compound wound generators is not sufficient to remove the effect of all the variations of speed in the water wheels from appearing in the motors, and these motors cannot run Fourdrinier paper machines, although motors in these mills, deriving their power originally from a steam engine, perform satisfactory work in driving paper machines. At these same mills an installation of motors is under way for the transmission of 1,200 to 2,000 h. p. for a distance of seven miles. As water-wheels give sufficiently uniform speed for looms, and as motors do give a more uniform speed, there is but little question as to their mechanical suitability for such work.

The third class of applications for electric motors is in connection with long distance transmission of power for the purpose of bringing the energy of a water privilege to a locality more convenient for manufacturing. The problems of short distance transmission already considered are as different from those involved in the transmission for a long distance as river navigation differs from that on the ocean, and the extent to which these long distance problems have been mastered was shown by the transmission of 300 h. p. 109 miles, through No. 6 wire, at the Frankfort Exhibition in Germany last year. There are power transmissions in California for mining machinery for long distances, some of them being 27 miles, but I am not aware that any such great distance has been applied for driving textile machinery.

The electric lighting and power used in Hartford, Conn., is derived in part from a water-power at Tariffville, 10 miles away, and some 300 h. p. is transmitted along the wire that distance and thence distributed to customers around the city.

The Nonotuck Silk Company is supplying to its mills at Leeds and Haydenville power transmitted by electricity from a dam in a rocky gorge in the river about a third of a mile from one mill, and a mile and three-quarters from the other. The installation is not cited as being on a large scale, but because it contains many ingenious features in the manner in which the motors are applied as an auxiliary and a regulator to the water-wheels. The fall of thirty feet is situated between steep banks where it would not be developed under ordinary conditions, because the spot is unsuitable for the location of a mill. There are two water wheels in use, one of 90 h. p., driving dynamos which furnish 950 incandescent lamps on an alternating system at the mills. The other, 130 h. p. water wheel drives one Thomson-Houston generator of 85 h. p. and another of 30 h. p., the pressure of the current being the same as that used on trolley street cars. At the mills one-third of a mile distant is one motor of 45 h. p., two of 20 h. p., and one of 10 h. p., all supplied by electricity from the 85-h. p. generator.

The 45-h. p. motor belts upon the main shaft, which is driven by two water wheels having a capacity of 100 h. p. under a 12½ foot fall. The water wheels are run at full gate without any regulator, but the motor serves as a regulator running at uniform speed and furnishing the remainder of the power, which has a variable range of 25 h. p. When the water falls too low for the water wheels and motor to run the mill, a steam engine is belted to the main shaft, the motor and water wheels furnishing their full capacity, and under these conditions the engine regulates the speed of the whole. It is an important precaution to set the governor on the engine for a speed slightly greater than its proportion to the motor and water-wheels, so that it will lead and also prevent the motor from tending to do more than its proper capacity. The other three motors are used to drive the machinery in an adjoining mill building, and they are connected directly to the shafting, one in each room. The 50-h. p. generator at the power station operates a 45-h. p. motor in the mill at Haydenville, a mile and three-quarters distant. The arrangement of motor, turbines and engine is the same as at the lower factory, but placed in a more compact manner. Arrangements are being made for an increase of this electric plant.

There are several places in New England where the power of waterfalls is being applied through electrical apparatus to machinery at a distance, and there are numerous extensive enterprises of this nature under construction. The electric transmission of power under any practicable conditions of constant or variable speed at a loss not exceeding twenty per cent. has been shown to be entirely practicable, and the open question in regard to all of these devices, whatever may be their purpose, is but the question of cost.

It was my privilege at a meeting of this Association held ten years ago to present a paper on the subject of "Electric Lighting of Mills." The applications of electrical illumination have grown during these ten years to such an extent that the daily manufacture of incandescent lamps in this country is now three times the whole number of incandescent lamps then in use in the United States, and I believe that there is no reason to question why there will not be in this decade a comparable increase in the applications of electricity to the transmission of power.

*Abstract of a paper read before the New England Cotton Manufacturers' Association, Oct. 26, 1892.

Load Limits of Bipolar Dynamos.

BY A. D. ADAMS.

In the valuable paper on "Heating of Armatures," by Harris J. Ryan, in THE ELECTRICAL WORLD of Oct. 22, 1892, statements are made concerning the "normal output," or load limit of bipolar dynamos, with which the writer can hardly agree.

Mr. Ryan says: "The normal output of current is thus determined as that which will not produce in conjunction with the heating of the core a rise of temperature of more than 75 degrees centigrade in a given armature operating at normal pressure."

He also says, speaking of one of the machines tested at Cornell University: "Four years ago, when this armature was designed and first built, its intitial temperature was 50 degrees centigrade, and its normal output of current was rated at 300 ampères. To-day, with a core made up of the best iron that the market supplies, this armature has an initial temperature of only 30 degrees centigrade, and the safe current output has justly been raised from 300 to 400 ampères."

Three things limit the "normal output" of a dynamo: sparking at the brushes, heating and loss in armature conductors.

If a bipolar dynamo of given frame is to be wound for the largest output it will deliver in a satisfactory manner, without using an excessive amount of wire or current to force magnetism across the air-gap, sparking and its causes determine its "normal output," rather than either heating or loss in armature conductors.

As an illustration, take a bipolar dynamo, with an output of 200 ampères, which operates at this load with a rise in armature temperature of 75 degrees centigrade, and without objectionable sparking or demagnetizing effect of armature. If this dynamo has its armature rewound with one-quarter its former resistance, 400 ampères, or twice its former load, can be drawn from it without greater temperature in armature windings than at first, as the loss in armature windings, C^2R, is the same in both cases.

The thicker winding on the armature will make necessary a larger air gap, and consequently more ampère turns on the field magnet. It is evident that the additional copper required on armature and field magnet will cost much less than another machine like the first, but how will such a reconstructed machine act?

The ampère-turns on the armature being doubled the cross magnetizing effect will be doubled, the lead increased, and the demagnetizing effect much more than doubled. Unless the dynamo was much underrated at first, the increased change of lead, tendency to spark, and demagnetizing effect of armature will render the machine entirely unsatisfactory, notwithstanding the fact that the temperature of the armature is the same as at first.

The above indicates that the troubles which cause sparking are what really limit the "normal output" of bipolar dynamos, and not the loss of pressure or heat in armature conductors, which can readily be varied by varying their section.

It may be said concerning the dynamo mentioned by Prof. Ryan, which had its output raised from 300 to 400 amperes, that either its design was uneconomical at first or else there is too much tendency to spark and too great a demagnetizing effect of armature as at present rated. For if it works properly now its armature might have been wound at first with a larger conductor and operated at its present rating with no more heating than with the smaller load.

An English Combination Plant.

The combined engine and dynamo illustrated on this page is manufactured by Messrs. Ernest Scott & Mountain, a firm well known in England for the excellence of its workmanship, and whose factory is situated at Newcastle-upon-Tyne.

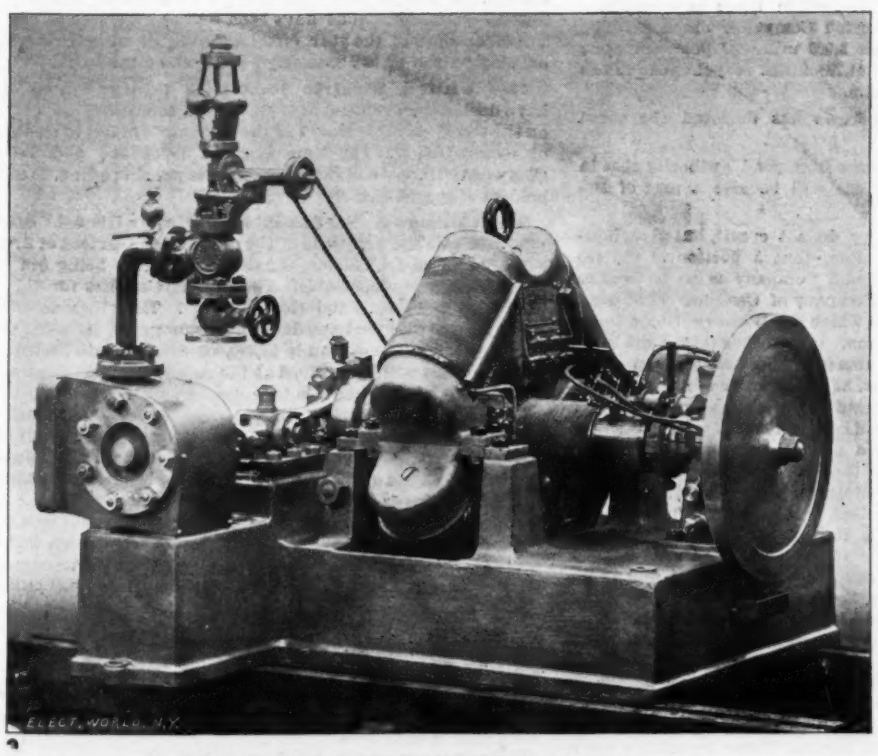
The very compact horizontal engine enables this plant to be used in places where there is not sufficient head room for the vertical type, more especially in men-of-war. The valve is worked by a return crank keyed to the crank pin, which is forged solid with the crank plate upon the dynamo spindle.

The dynamo is of a pattern new to this country, having four poles, carried on brackets resting on uprights upon the bed plate, which is extra deep and wide. The construction of the magnets will be readily seen from the engraving, and the whole is very easily fitted together after the parts are machined. The bearings are very long and are lined with white metal, and the whole complies with British Admiralty requirements. The plants are made in sizes from 3,000 watts for yachts up to 15,000. The smallest size has a steam cylinder 5-inch bore × 4-inch stroke and runs steadily at 400 revolutions, the dynamo being equal to 3,000 watts at that speed. The total weight is 2,016 pounds and the whole plant is contained in a space of 4 × 4 feet × 3 feet high, and is sold in England for a net price of £500.

The Acton Pressure Regulator.

The Acton pressure regulator is not a new device, having been known in some of its forms for a number of years and its merits recognized. The inventor, Mr. John Acton, 191-193 Worth street, New York, however, has lately made some important improvements and a modified type is shown in the accompanying illustration.

This regulator is intended to automatically control the pressure at any point regardless of the initial pressure. It is claimed that it will maintain the pressure absolutely constant to within one or two pounds, however great the variation. Its construction is very simple, all its parts being metal, and it is practically impossible for it to sustain injury in any way, so that its life is very long, especially in electric light work. It is highly important to have all such devices of the most substantial construction, for anything that results in the stopping of an engine or dynamo means financial loss as well as trouble in other directions.



AN ENGLISH COMBINATION PLANT.

Even in case an accident should happen to this regulator, which hardly seems possible, it can immediately be converted into an ordinary globe valve, so that such an accident would not require the stopping of the engine. It is compounded in the ratio of 16 to 1 and it will instantly respond to the slightest variation.

This regulator is especially designed to control high pressures, and is applicable to the steam pumps of hydraulic elevators, fire pumps, water-works and similar installations. Its field in electric light work should be especially large, as great variations in load are constantly experienced and some form of reliable pressure regulator is a necessity. During the past few years a large number of Corliss engines have been destroyed, causing great damage, as well as complete stoppage of the plant, simply because the ordinary governor failed to work. It is claimed that if this pressure regulator had been attached these accidents would have been rendered impossible, since it is a governor in itself; and even if the ordinary engine governor was completely destroyed it would entirely fill its place. Its

THE ACTON PRESSURE REGULATOR.

sensitiveness compares quite favorably with that of any engine governor, and it is claimed by the inventor that it will bring the engine back to normal speed within three revolutions, no matter how great the change in load may be. These regulators have been adopted by the Edison stations in New York, as well as by many other large plants throughout the country, and have been also applied to elevator installations, such as that in the Times Building, and to water-works, and reports are universal in its favor.

The Germania Universal Tin Shade.

To those already familiar with the Germania universal shade holder the convenience of the tin shade recently devised by the Germania Electric Company, of 620 Atlantic

THE GERMANIA TIN SHADE.

avenue, Boston, and herewith illustrated, will be at once apparent, it being essentially that shade holder stamped directly from the material of the shade itself, and applicable to any socket without the difficulty of adjusting screws or centring.

The holder attachment consists of four little lugs or fingers stamped from the centre of the shade, the ends of these lugs being then turned upward for about a quarter of an inch, and outward again just sufficiently to form a catch for the clamping ring, which is adjustable to the size of any of the sockets on the market by means of the screwwhich fastens it together.

To apply this shade to any of the regular sockets the ring is removed and the lugs sprung around the outside of the socket shell and allowed to rest upon the fillet at the edge of the shell; the ring is then placed around the outside of the lugs and the screw tightened so that the shade is clamped firmly in place. When it is desired to attach this shade to the regular Edison socket, the ring is dispensed with entirely, and after removing the rubber bushing from the socket the lugs are pushed inside the shell where the little projections catch in the fillet of the socket shell, allowing the bushing to be screwed into position again, which, in entering the shell, holds the shade securely.

This construction has the advantage of having holes around the socket which allow a circulation of air tending to cool the lamp, a material factor in lengthening the life of the filament.

It is not intended to make these shades in any finish other than with a fine enamel which gives a smooth white surface, wearing for years, and which can be readily washed and kept clean, a material much preferable to lead paint in retaining its color and not becoming yellow by age. On the outside the finish is a fine glossy green Japan.

Activity of the Ft. Wayne Company.

The Ft. Wayne Electric Company, of Ft. Wayne, Ind., is doing a large and growing business. That it deserves to do this no one can question who will pay a visit to its factory. Mr. J. J. Wood, the electrician of the company, combines in a marked degree the capable electrician with the equally capable mechanic. The result is that the devices turned out by the company are excellent mechanically as well as electrically. No fewer than 20 different kinds of lamps are manufactured by the Ft. Wayne company—arc lamps, incandescent-arc lamps, alternating current lamps, and all the different modifications. The factory has a capacity of 120 lamps a day, and actually turns out 90 lamps a day. No fewer than 35,200 Wood lamps have been manufactured and sold in two years and eight months, while 604 Wood dynamos have been sold in the same time. Mr. Wood has just completed a new alternating current lamp which is simplicity itself and promises to give the most satisfactory results.

He has also recently put upon the market a new dynamo, and is working upon a new meter and a new alternator which he hopes soon to have ready. It will thus be seen that Mr. Wood is as active as ever. The Ft. Wayne company completes on the average one arc dynamo every working day, ranging all the way from 1 to 80 lights. One constant current arc machine of 150 lights capacity is shown to visitors that has 6,800 volts difference of potential at the binding posts and 7,200 difference at the brushes. This is a successful dynamo, and does excellent practical service, but is not a machine that can be "handled without gloves."

Mr. C. S. Bradley, formerly of New York, is making elaborate and so far very satisfactory tests with his new triphase system. The Ft. Wayne company looks for most gratifying results from Mr. Bradley's triphase motor and triphase alternator which, however, owing to the care taken in "working out" these results as they are obtained, will probably not be put upon the market for several months to come. Mr. Brainard Rorison, who looks after the general business management of the Ft. Wayne Electric Company, has a wide acquaintance with the electrical field in the West, and is an active and progressive business man of the "be sure you're right, then go ahead" school, Mr. Rorison has done some very good work, both for the old Indianapolis Jenney Company, of which he was the head, and also for the Ft. Wayne Company after the consolidation. So highly are his business ability and good practical common sense appreciated that a strong effort was made some time ago to induce him to accept a most flattering offer in the East, which he, however, thought best to decline.

Tests of Large Steam Locomotives: A Correction.

In the article on this subject by Mr. C. K. Macfadden, the electric light inspector of the Northwestern Railway system, which was printed in THE ELECTRICAL WORLD of Oct. 22, an annoying error crept in by the transposition of the figures showing the mean effective pressure in pounds in the indicator cards given in Figs. 1 and 2, on page 256. Those who are acquainted with the operation of steam engines would see at a glance that the figures in these two cases had been transposed, and that in Fig. 1 the mean effective pressure should have been 55 and 56 pounds., and Fig. 2, 43 and 39 pounds, instead of being given in the reverse order as they occur in the drawings.

A Prize Offered.

A prize of 3,000 francs has been offered by Baron Leon de Lenval, of Noce, to the inventor of the best application of the principles of the microphones in the construction of microphones, or of a portable apparatus for the improvement of hearing of deaf persons. Instruments for competition must be sent to Prof. Adam Politzer, or Prof. Victor von Lang, Vienna, before Dec. 31, 1893. The prize will be awarded at the Fifth International Otological Congress at Florence in September, 1893. The following are the members of the jury: Prof. Adam Politzer, president, and Prof. Victor von Lang, Vienna; Dr. Benni, Warsaw; Prof. Gazzt, Dr. Gellé, Paris; Prof. Urban Pritchard, London; Prof. St. John Roosa, New York.

NEW BOOK.

THE SCIENTIFIC AMERICAN CYCLOPEDIA OF RECEIPTS, NOTES AND QUERIES. Edited by Albert A. Hopkins. 705 pp. Munn & Co., 1892. Price $5.

The demand for this compilation has been so great that already the second edition is on the market, revised to date and containing 30 pages more than the original edition. The book is made up very largely of matter which has appeared in the columns of the *Scientific American* for the past 50 years. Upon this as a basis important additions have been made and the old material well revised and condensed to form the present volume. The material is arranged by subjects alphabetically, and in it will be found thousands of items giving information upon matters of everyday interest to the engineer, the metal worker and the artisan. Among other subjects may be mentioned batteries, electrometallurgy, alloys, rubber, tanning, varnishes, welding, etc., etc. A copy of this book should certainly be in the hands of every experimenter who is called upon to manipulate materials with which he is more or less unfamiliar. As a work of reference in the field it covers it is unequaled.

Financial Intelligence.

THE ELECTRICAL STOCK MARKET.

[Inquiries from our patrons for information relative to stocks and bonds of the various electric light and power companies are solicited, and will be answered in this column.]

NEW YORK, Oct. 29, 1892.

New York Financial Stock Market.—Of twelve active stocks traded in last week six scored an average advance of 1⅛ per cent., and six an average decline of 1⅞ per cent. The total number of transactions aggregated 2,241,616 shares. Of this amount 1,102,055 were Reading, New England and Distillery and Cattle Feeding Trust. The New England deal whereby Philadelphia capitalists, in the interest of Reading, obtained 60,000 shares of Boston & Maine, and then bought control of New York & New England without the knowledge or consent of its management, was consummated. The activity in Distilleries was brought about by professional manipulation, and is said to be based upon news yet to be announced. The market for the industrials was up to an average activity. Values were sustained. The tendency of money rates is downward, owing to large sums seeking placement. Commercial paper was limited in supply, and buyers have reappeared in the New York market. Money is reported firm in Western points, being active in Chicago, Milwaukee and Pacific Coast points. In the South it is easier. In Chicago New York exchange is at 25 cents premium, as against 40 cents last week. In the commercial world the excessive stocks of wheat in the market have had a depressing tendency. The price has dropped to 75 cents, the lowest in years. So great is the movement that Western roads are all practically blockaded. At some centres it is impossible to move 10 per cent of the tonnage which is on wheels. Trade conditions in the South have improved materially and are now fair. The Northwest feels the mild weather, winter purchases being delayed. At the Western commercial centres trade is brisk. The boot and shoe business continues in excess of last year. The metal markets are firm. Bank clearings in 68 cities show a decrease of 1 per cent. The business failures aggregated 220, as compared with 205 for the corresponding week in 1891.

Closing Quotations.—The following were the closing quotations of electric stocks on Saturday, Oct. 29, 1892, and the range for the week in New York:

NEW YORK QUOTATIONS.

	Par.	Capital outstanding.	Lowest.	Highest.	Bid.	Ask'd.
American District Tel....	100	3,825,000	60	60	59	60
American Tel. & Cable..	100	14,000,000	86	87	85½	87⅛
Central & So. Am. Tel....	100	6,000,000	....	....	..	..
Commercial Cables.....	100	7,716,000	....	....	164	169
Gold Stock & Tel	100	5,000,000	..	....	100	103
Bonds.....	500	500,000	....	....	100	..
Postal Tel. & Cable.....	...	10,000,000	....	....	62	64
Southern & Atlantic Tel..	25	948,775	....	....	78	84
Western Union Tel.....	100	86,199,852	98	99⅛	98¼	98⅛
Real estate bonds.....	1,000	1,219,000	115⅛	115½	....	..
Debenture bonds.....	1,000	4,920,000	....	....	....	....
Collateral Trust 5's....	1,000	8,181,000	103¼	104	....	....
North American.....	100	39,767,200	12⅝	12⅞	13	13⅛
Brush Ill. Co. of N. Y.....	50	1,000,000	....	....	30	60
Edison El. Il. of N. Y.,....	100	6,500,000	105½	106⅛	105½	107
" " Ists.	...	.....	107⅛	108½	...	.
" " Deb's... ..	...	.....	....	....	...	....
Edison El. Il. of Brooklyn.	100	750,000	....	....	85	90
" " " " Chicago..	100	750,000	....	....	130	145
" " " " Boston...	...	.....	....	....	115	125
Edison El. Lt. Europe....1,000		2,000,000	....	....	2	6
" Bonds....		30,000	....	. ..	65	80
Edison Ore Milling Co.... ...		2,000,000	....	....	15	20
East River El. Light.....	100	1,000,000	....	....	..	65
General Electric	1,000	50,000,000	115⅝	117⅜	115½	116
Debenture 5's		.....	105¼	106⅞	....	....
Automatic Exhibition Co. ...		2,500,000	. ..	....	3	5
Mt. Morris Electric..... ...		500,000	....	....	....	65
N. E. Phonograph.....		2,000,000	....	....	2	4
N. Y. Phonograph		2,000,000	....	....	2	5
N. American Phonograph ..		2,000,000	....	....	4	6
Westinghouse E & M. Co. 1st p. 7 per cent. Cum.	50	3,717,253	....	....	....	....
E. & M. Co. Assg.....	50	5,038,116	....	....	....	....

NEW YORK ELECTRICAL STOCK MARKET.

In General.—The market, in this particular class of securities was devoid of incident. Even the rumor monger deserted this field at the expense of the Distillery and New England stocks. Transactions were below the average and values stable, with very little net change. Western Union scored a decline of ¾, Edison Electric Illuminating advanced 1, General Electric ⅛, and North American declined ¼. The attention of the speculating element, which created activity in the list during the several weeks just preceding, was turned to the more active securities. American District Telegraph at 60 and American Telegraph and Cable at 86 to 87 were traded in. There is at the present time very little market for these securities. The current prices have ruled for weeks. North American secured a number of sales of small lots at 12⅝ to 13. From the nature of transactions it is easy to infer that none but the general public, and "small fry" at that, are doing anything in the stock. A number of the sales were for 10, 20 and 50 shares each. There can be no immediate prospect of an advance based upon improved earning capacity, etc., when the wealth back of the company does not find it advisable to lay by a stock at present low quotations.

Edison Electric Illuminating—The opening price was 105⅛ to 105¾, the closing 106⅛. Transactions were few in number and of comparatively round lots. There was considerable demand for the first 5's bonds; $46,000 sold at 107⅛ to 108¼, an advance of about ¾ over the previous week. It is said that the differences between the company and the New York Board of Underwriters, involving the grounded current system, have been adjusted. The strike of the electric wiremen, which was ordered during the latter part of the week, will probably not seriously affect the company. About 400 men are directly involved. They object to the employment of non-union men. A settlement is not in sight at this writing. The company listed the following additional securities on the New York Stock Exchange this week: $300,000 capital stock and $50,000 additional first mortgage 5's. Total stock listed, $6,100,000. First mortgage bonds listed $3,100,000.

General Electric.—"Firm and quiet" is the diagnosis of the career of this stock. The volume of transactions fell off somewhat. The closing was strong. With an upward turn in the general market we look for an advance to this security. The annexed table gives the range of quotations. The debenture 5's sold to the extent of $22,000 at 105 to 105¾. The counsel for the Edison and the United States Electric Lighting companies have reached an agreement relative to costs in the incandescent lamp case recently decided by the Circuit Court of Appeals. The sum agreed upon, $781.50, has been paid into the treasury of the General Electric Company.

Western Union.—The market seems to be waiting for the issue of the $10,000,000 new stock finally agreed upon. Its effect upon values is of course uncertain, being largely contingent upon the action of its powerful financial backers. If rendered no artificial support it will have the effect of a supply greater than a demand would have in the commercial world. This would not of necessity be permanent. However, in the world of Wall street things are often logical because they are illogical. The new stock represents money extended in betterments, and consequently will not create a new value. The present price of 98 to 99⅛ has been made in discount of this 10 per cent. new issue, and if the market takes a logical course it will sell off 10 points ex-dividend. The directors will meet next Tuesday to act upon the distribution. A number of sales of Collateral Trust 5's were made at 103⅛ to 103⅞. One lot the first in many weeks, of debenture 7's sold at 115½.

Westinghouse.—A number of first class securities were not even called in the "bid and ask" lists, much less traded in. Among these was the Westinghouse common and preferred. There is apparently a pronounced indifference as to the course of this stock. Owners, while satisfied to the extent of holding on, do not attempt to acquire additional stock, while non-owners do not evince sufficient interest to make a bid. Concerning the finances of this company a contemporary says: "To be conservative, allow that the monthly net earnings of the Westinghouse Company average $100,000 for the year; that would aggregate $1,200,000 net earnings. Now, to pay 7 per cent. on the preferred requires less than $280,000, but call it that, and to pay 7 per cent. on the common $420,000 is necessary. Hence to pay 7 per cent. on both classes of these stocks, $700,000 is all that is needed, whereas the net earnings of the company are between $1,200,000 and $1,500,000, or between 12 and 15 per cent. on the entire capital."

WALL STREET NOTES.

Copper Market.—As high as 11½ cents was bid this week for lake copper, spot delivery. Sales were made at 11¾ cents. The current offer is 11⅞ cents for nearby delivery. There has been little or no contracting for supplies covering the winter months. The companies are willing to take orders for that period at 12½ cents, thereby adding to the current quotation the increased rail freight. Consumers are waiting in anticipation of a slump in the market. The companies hold the stocks, and if the present stability continues will be able to place the market on a 12½-cent basis by Dec. 1.

Erie Telephone and Telegraph Company's sub-companies have made a net gain of 298 subscribers for the quarter ended Sept. 30; total instruments connected 14,727.

American Bell Telephone Company's statement of instrument output for the month ended Oct. 20 makes the following showing:

October:	1892.	1891.	Increase.
Gross output.....	7,434	5,272	2,162
Returned.....	3,944	4,224	*280
Net output.....	3,490	1,048	2,442
Dec. 21 to Oct. 20:			
Gross output.....	79,819	58,590	21,229
Returned.....	45,944	35,573	10,371
Net output.....	33,875	23,017	10,858

* Decrease.

At the Western Union meeting held for the purpose of acting upon the stock dividend, 651,327 shares voted in favor of increasing the capital stock; 100 shares voted against it. A resolution was offered by Col. Reiff, instructing the directors not to distribute any part of the stock as a dividend, was lost by the vote of 635,640 to 100 shares. Mr. Jay Gould said that the directors had determined upon no plans as yet for the distribution of the stock. Mr. Sage stated at the meeting that he should like to have a 10 per cent. distribution of the new stock to the stockholders as a dividend and have the balance given to the directors to dispose of for the good of the property.

Dow, Jones & Co. say that there is talk of an agreement relative to the use of incandescent lamps between General Electric and Westinghouse, instead of another fight in the courts over the new Westinghouse lamps.

The rate for long distance talking between Chicago and Boston has been fixed at $9 for each five minutes. It is probable that a reduction will be later made in the entire long distance service for extended conversation. At present only about six five minute conversations in each hour can be put upon a long distance circuit, as one-half the time is consumed in establishing connections, making appointments, etc., for which there is no charge. The American Telephone and Telegraph Company, which is Bell's long distance company, has about 3,000 miles of pole lines, but there was a total Jan. 1, 1892, of 41,298 miles of pole lines in the extra territorial and toll lines system.

Erie Telegraph and Telephone has declared the usual quarterly dividend of 1 per cent.

The Boston *Beacon* says it comes from good authority that in less than 30 days the Westinghouse will become a part of the General Electric Company:

There are rumors afloat—which we do not credit, but give, inasmuch as they record interesting data—that a portion of the increased capital of the Western Union Company is to be used to absorb the Montreal Telegraph Company of Canada. This company has a capital of $2,000,000, on which the Western Union Company guarantees $165,000 per annum. Report has it that the basis will be two shares of Western Union stock for one share of Montreal Telegraph. This would mean, at present rate of five per cent. dividends, $200,000 per annum, instead of $165,000, as at present, but the Western Union Company would relieve itself of a fixed charge, and by working the company as a part of its own system, could effect economies that would more than offset the extra charge. It is believed that this course has been urged upon Western Union by the Vanderbilts, who were surprised, on assuming control of the Rome, Watertown & Ogdensburg Railway, to find that the Montreal Company not only owned the telegraph franchise on this entire system, but also on the Central Vermont Railway and Delaware & Hudson Railway, north of Lake Champlain, as well as the Adirondack railways. The Montreal Telegraph Company also owns the franchise on the Vanderbilt lines running between Buffalo and Detroit. They also control a large portion of the State of Maine through the Grand Trunk Railway and its allied systems. They control the franchises on the Intercolonial Railway, over which the Western Union Telegraph and Anglo-Cable companies reach their Atlantic cable landings in Nova Scotia. These franchises are a menace to the Western Union Company, and, valued on the same basis as similar rights in the United States, are considered worth more money than the $4,000,000 of Western Union stock to be exchanged.

BOSTON, Oct. 29, 1892.

The general market of the week has been the best one all around that we have been favored with for a very long time. The bulls have held by far a majority of the power, and their exertions to broaden the market and insure a steady and firm foundation for speculation have met with reasonably good success. The reaction that naturally follows days of strength and activity has been less severe than usual, and nearly all the gains have held up. Toward the latter part of the week, however, the traders felt more inclined to take their profits where they saw them, and by throwing so much stock on the market the progress of prices was materially checked and brought to a decided standstill. There is an unmistakably strong undertone to the general list, and a decided strength in a few specialties, which latter are subject to rather violent fluctuations. In local stocks the Bay State Gas, which was so active and strong last week, has simply been let alone, and has maintained its real strength, though small sales have tendered to lower the price fractionally. West End Railway stands still on its merits, with no change and very light sales. The money market continues strong, and the rates are still high. Nearly all loans range at 5 to 6 per cent. Conditions are such as to render a change to cheaper rates possible, but the demand is so active that it keeps the rates high.

The electric stocks have sold in small quantities every day, but the railroads have rather absorbed the public interest, so far as stocks are concerned, and only the friends and supporters of the electrics are paying them any attention whatever. The quotations show a slight but gradual decline in General Electric during the week, but still its present figure is considerably above the average on this stock for, say, the past two months. The rumors of a lack of support seem to have been rumors only, and without foundation, and both the common and preferred are as attractive as ever. Westinghouse is, as usual, well supported, and, though the sales have been very light, still they show a slight advance for the week. The influence of the lamp decision was of slight value, either to depress this stock or raise General Electric, and has now been quite forgotten. Toward the end of the week some very active buying put the price up three points to 40, proving by a good test that there is life and good support to the stock. Bell Telephone fell off to 206½ on very small sales, due probably to a forced sale. This stock has shown unusual strength of late, but for no particular reason, other than a response to the generally good condition prevailing in the market. The other telephone stocks have been very quiet, with infreqent sales. There is a good interest in copper stocks, and for some time past they have maintained good prices. Boston & Montana has been the most active, at about 35. The closing prices of the week are about three points below those at the opening, but it looks more like manipulation of the bear element than any real weakness of the stock. The stock is certainly very attractive at present prices, based on all reports from the mine and upon actual output, and cost of production in comparison with the present market on copper. Osceola is next in activity and remains strong at about 33, with not very large sales. Calumet & Hecla at 290 is of course subject to little or no fluctuation, as is also the case with Tamarack at 160, both of which are quite firmly fixed in value, and the holdings change very seldom and only in small sales.

The United Electric Securities Company, of Boston, has issued a new circular inviting proposals for the sale to the company of $40,000 of its collateral trust 5 per cent. bonds, of the sixth series. The proposals will be received until Monday, Nov. 7. There are outstanding now in this series $900,000 bonds, from which amount this $40,000 will be deducted if purchased by the company.

The Chicago City Street Railway Company carried 1,582,640 people during four days last week. The receipts of those four days were $79,132, against $45,143 during the same days of last year. The company will be prepared next summer, with greatly increased facilities for transportation, to carry upward of 1,000,000 people a day.

The Newton (Mass.) Electric Street Railway's annual report as presented to the railroad commissioners shows the following operations, ending Sept. 30:

Income.....	$62,866	Increase over last year.....	$12,928
Expenses	40,225	" " " "	2,321
Profit.....	$22,641	" " " "	11,169
Interest....	7,417		
	$15,224		
Dividend.....	9,450		
Surplus.....	$ 5,773	" " " "	695

Stock $135,000. Debt $100,000. Cash balance $3,009

The debt of $29,750 outstanding Oct. 1, 1891, has been funded into stock, leaving only $200 of floating debt, which is due old stockholders of the Waltham & Newton Company for ten shares of stock. All the $100,000 of 6 per cent. bonds have been called and paid, and $100,000 5 per cent. bonds have been sold at 2½ per cent. premium. These fundings of the year effect a saving of interest during the ensuing year of $2,400, or nearly 2 per cent. on the stock.

The United Electric Securities Company, of Boston, have declared a dividend of 1½ per cent., equal to $1.50 per share on the stock, payable Nov. 1 at the company's office, to stockholders of record Oct. 27. The New England Telephone and Telegraph Company will pay a dividend of 75 cents per share Nov. 15 to stockholders of record Oct. 31.

The Chicago & St. Louis Electric Railroad Company offers for sale the first issue of the stock to the extent of fifty thousand shares, at four dollars per share, par value being ten dollars full paid and non-assessable. The subscription list for this stock will be opened Nov. 1 and closed Nov 7. The stock is offered at this figure to provide immediate means for prosecuting the work on the road-bed. The capital is $7,000,000 divided into 700,000 shares Subscriptions will be received at the Atlas National Bank and National Bank of Commerce in Chicago. Payments will be made by 20 per cent. on application; 30 per cent. on allotment; and 50 per cent. thirty days after allotment. The company has already secured valuable terminal facilities and entrances in both Chicago and St. Louis, and rights of way along the route of the road, besides valuable coal rights in territory through which it will pass. Besides the traffic of the road, it is expected that there will be a large income from the electric light and power business, which will be connected with each power station in the cities and towns on the route. On a conservative estimate, reckoning from the present bulk of passenger traffic and mail and express business, it is expected that the company will earn from 5 to 15 per cent. net. The through business at present between these cities averages twelve hundred passengers per day. The mail contracts are worth two hundred and ten thousand dollars per year. The express business averages over five hundred thousand dollars per year. A fair estimate of revenue for a year is as follows.

Passenger traffic (average 600 per day at $5).....	$1,095,000
Mail business.....	300,000
Express business.....	500,000
Light and power distribution (average 5,000 h. p. at $200 per year.....	1,000,000
	$2,895,000

YEARLY EXPENSE.

Operating expense, etc.....	$450,000
Interest on $7,000,000 bonds at 6 per cent.....	420,000
	$870,000
Net earnings.....	$2,025,000

Equal to 29 per cent. on capital stock.

This company is receiving the indorsement and co-operation of prominent capitalists and railroad and business men in the West, and the enterprise has started operations with every evidence of signal and continued success, and completion in time to accommodate the business of the World's Fair.

BOSTON QUOTATIONS.

	Par.	Capitalization.	Highest.	Lowest.	Bid.	Ask'd.
Thomson-Houston Elec.—Series C	sh	40,000	9	....	8⅛	9
Thomson-Houston Elec.—Series D	sh	120,000	8	7⅝	7¾	8
Thomson Elec. Weld	100	1,000,000	....	....	....	....
Thomson European Elec. Weld	100	1,500,000	10	....	10	12
Westinghouse Elec.—New Com.	..	6,000,000	40	36¾	39	39⅛
Westinghouse Elec.—Pfd.	..	4,000,000	50¼	49⅛	49⅛	50⅛
General Electric	..	30,067,200	117¼	115⅛	115⅛	115⅞
" " Pfd	..	4,136,300	119	117¾	117⅛	118½
Fort Wayne Elec	25	4,000,000	12½	....	12⅛	12¾
Fort Wayne Elec.—Ser. A.	sh	80,000	....	....	7⅞	8
Detroit Elec	10	750,000	5¼	5	5	5½
West End St. Ry. Co.—Com	50	7,150,000	72¾	72⅛	72⅛	72⅝
West End St. Ry. Co.—Pfd	50	6,400,000	87¼	87	87	87⅛
American Bell Tel	100	15,000,000	208	206⅛	207	208
Erie Tel. & Tel. Co	..	4,800,000	47	....	46¾	47
Mexican Tel. Co	10	1,280,000	....	....	1	1.10
New Eng. Tel. & Tel. Co.	..	10,304,600	61¼	60	60	62
Tropical Tel. Co	10	400,000	....	....	....	20c.

CHICAGO QUOTATIONS.

Following are the quotations of telephone and electric stock furnished THE ELECTRICAL WORLD by C. V. Banta, Jr., 167 Dearborn street:

Telephone Stocks:	Bid.	Ask'd.	Electrical Stocks:	Bid.	Ask'd.
Chicago	214	....	Chicago Arc Light & Power Co	102	104½
Central Union	....	58	Chicago Edison Co	165	..

NEW INCORPORATIONS.

The Pittsfield Electric Company, of Naperville, Ill., capital stock $20,000, has been formed to furnish light and power. Geo. E. Royce, Alvin Scott, Jr., and Alvin Scott, Sr., are the promoters.

The Elmwood Electric Light Company, of Elmwood, Ill., capital stock $30,000, has been formed to operate steam and electric light plants. Edwin R. Brown, Laura S. Brown and E. L Brown are the organizers.

The Marengo Light and Power Company, of Chicago, Ill., capital stock $25,000, has been formed to furnish light and power. Herbert H. Hewes, Clarence H. Cummings and J. H. Brandt are the promoters.

The Home Electric Company, of Richmond, Va, capital stock $150,000, has been formed to furnish electric machinery, light, power and heat, etc. W. E. Taylor, A. Piggins, O. H. Russell and J. Hainwood are interested therein.

The Edison Illuminating Company, of St. Louis, Mo., capital stock $5,000, has been incorporated to furnish electricity for light, heat and power. J. J. Taussig, Aug. Gehner and F. W. Biebinger, all of St. Louis are the promoters.

Eliot Falls Electric Light Company, of Natick, Mass., capital stock $30,000, has been formed to manfacture, use and sell electricity for light, heat and power. Albert D. L. Richards, Arthur E. Appleyard and Samuel Singer are the promoters.

The Connecting Electric Railway Company, of St. Louis, Mo, capital stock $2,000, has been formed to construct and operate a passenger railway in St. Louis. Those interested are J. D. Houseman, Jr., F. W. Raeder and George MicnhSt. Louis, Mo,

The Chicago Traction Company, of Chicago, Ill., capital stock $1,000,000, has been formed to construct, equip and operate electric and horse railways, electric light plants, etc., etc. The organizers are Chas. Vogel, Chas. Vogel, Jr., and Thomas O'Brien.

The Miami Valley Railway Company, of Piqua, O., capital stock $10,000, has been formed to build and operate a line of electric railway between Piqua and Troy, O. The incorporators are W. P. Orr, L. M. Flesh, A. M. Orr, W. F. Steiner and Walter D. Jones.

The Eureka Light and Power Company, of Eureka, Kan., capital stock $30,000, has been formed to manufacture electric light and power and furnish same to the public. J. B. Clogston, D. B. Fuller, J. B. Pierce and H. L. Stoddard, all of Eureka, are the organizers.

The Magnolia Light, Heat and Power Company, of Warrensburg, Me,, capital stock $20,000, has been formed to generate and furnish electricity and gas for light, heat and power. W. P. Hunt, A. M. Zimmerman, J. T. Cheatham and W. H. Hartman are the promoters.

Consumers' Light and Power Company, of Little Rock, Ark., capital stock $200,000, has been started to construct, operate and maintain light, heat and power plants in this city, etc. B. E. Sweeny, B. J. Arnold, Geo. R. Brown, Geo. Martin and H. G. Allis are interested.

The Evansville Electric Company, of Evansville, Ind., capital stock $5,000, has been formed to manufacture, use and furnish electricity for motive power, lighting and other purposes, etc. John J. Shipherd, Alexander Gilchrist and Curran A. De Bryler are the incorporators.

The Lakewood Electric and Investment Company, of Denver, Colo., capital stock $50,000, has been formed to operate an electric car line in Arapahoe and Jefferson counties, Colo. Frank L. Gove, Geo. D. T. Rouse, Frank W. Loveland, Hedley V. Cooke and H. H. Martin are the incorporators.

The Indiana Tin-Plate Manufacturing Company, of Atlanta, Ind., capital stock $200,000, has been formed to establish electric light, heat, power and water-works, etc. Enoch Stanford, Elwood, Ind.; Matthew P. Elliott, Kokomo, and M. V. B. Newcomer, Tipton, Ind., are the promoters.

The West Almaden Quicksilver Mining Company, of San Francisco, Cal., capital stock $10,000,000, has been incorporated to erect electric light and power plants, etc., etc. The organizers are W. A. Keefer, John C. Quinn, Geo. Karolyi, Chris. Dunker and James A. Downing, all of San Francisco.

The Springfield Railway Company, of Springfield, O., capital stock $1,000,000, has been formed to construct and operate street railroads, furnish electricity for light, heat and power, etc. Wm. B. McKinley, Charles A. Harris, Samuel L. Nelson, Alvare S. Kratz and Oscar T. Martin are the promoters.

The Elwood Electric Street Railway Company, of Elwood, Ind., capital stock $100,000, has been formed to construct and operate lines of railroad in Elwood, to furnish electric light, heat and power to Elwood, etc , Gustave Kramer, Jas. H. De Hority, and Henry C. Calloway are the organizers.

The Atchison Electric Motor and Street Railway Company, of Atchison, Kan., capital stock $500,000, has been formed to construct an electric railway on the streets of Atchison, Kan. A. J. Howri, J. C. Fox, W. F. Dolan, J. T. Heisey and A. W. Simpson, all of Atchison, are the promoters.

The Suburban Electric Light and Power Company, of St. Louis, Mo., capital stock $10,000, has been organized to furnish electricity for lighting, heating and power purposes to incorporations and private individuals. Walter Krausnick, S. W. Simmons and Gus George, all of St. Louis, are the promoters.

The Beaver Meadow Hazelton, Mahanoy & Shenandoah Railway Company, of Hazleton, Pa., capital stock $150,000, has been formed to construct and operate an electric railway in Carbon, Schuylkill and Luzerne counties. A. Markle, J. J. McGeehen and N. C. Yost, of Hazleton, are the promoters.

The United Columbian Electric Company, of Camden, N. J., capital stock $800,000, has been formed to manufacture and sell electric motors, dynamos, batteries, etc., and to furnish electric lights. A. G. Hetherington, C. W. Kennedy, Henry Groswith, of Philadelphia, and Marcus B. Taylor, of Keyport, N. J., are the organizers.

The Shamokin & Mount Carmel Electric Railway Company, of Shamokin, Pa., capital stock $100,000, has been formed to construct and operate an electric railway in Northumberland County. H. S. Robins, Mt. Carmel, Pa.; E. C. Hamilton, Shamokin, Pa., and David J, Lewis, Mt. Carmel, Pa., are the incorporators.

The Columbia Light and Power Company, of Portland, Me., with a capital stock of $200,000, has been formed to carry on a general electric light and power business and to manufacture and deal in lumber. Isaac C. Wyman, Salem, Mass.; James H. Wheeler, Jr., West Newton, Mass., and Isaac C. Atkinson, Portland, Me., are the incorporators.

The Cripple Creek Telephone, Electric Light and Power Company, of Fremont, Colo., capital stock $100,000, has been formed to establish, maintain and operate telephone lines, electric light and power plants, etc. R. Newell, Jr., L. D. Roudebush, E. J. Eaton, H. H. Bell, W. B. McClelland, John Hazletine and E. E. Power are the incorporators.

The Eickemeyer-Field Manufacturing Company, of Yonkers, N. Y., capital stock $1,000,000, has been formed to manufacture and sell electric machinery and equipments. This company is formed by the consolidation of the "Eickemeyer Field Company, Eickemeyer Dynamo Company" and "Yonkers Machine Company." Edward A. Nichols, 13 Astor place, New York City; Henry Osterheld and Stephen D. Field, of Yonkers, are the incorporators.

Special Correspondence.

NEW YORK NOTES.

OFFICE OF THE ELECTRICAL WORLD,
167-176 TIMES BUILDING, NEW YORK, Oct. 31, 1892.

We were in receipt of a pleasant call last week from Mr. James B. McCreary, dealer in electrical specialties, Buffalo. Mr. McCreary has just secured the territory west of Syracuse in New York State, for the specialties manufactured by the National Electric Company, of Eau Claire, Wis.

The warerooms of Alexander, Barney & Chapin, of this city, have always been an attraction that has drawn the out-of-town customer, but their latest addition, that of a beautiful ornamental "Ward" arc lamp, which throws its soft and balmy rays on one as he enters the outer portals, will serve as a magnet that cannot be resisted. Already their trade has increased perceptively.

At a meeting of the New York Board of Underwriters the committee which has been conducting the discussion with the Edison Electric Lighting Company concerning the failure of that company to conform to the board's rules of safety reported that the Edison company has now conceded the correctness of the board's requirements, and has promised to proceed with all possible speed to make its system comply with those rules. Upon this assurance the underwriters voted to resume the inspection of Edison instalments and wiring.

To Avoid an Injunction.—D. F. Lewis, President of the Brooklyn City Railroad Company, at midnight Saturday, sent 100 men to the Manhattan crossing on Flatbush avenue, Flatbush, and before 4 A. M. had laid the tracks for the new electric branch of the Brooklyn City line across the tracks of the Manhattan Beach road Austin Corbin was to have served an injunction to prevent this work being done, but as no papers had been served at midnight Saturday President Lewis took advantage of his opportunity, and cleared the way for further extension of the trolley line. L. H. H.

PHILADELPHIA NOTES.

PHILADELPHIA, Oct. 22, 1892.

Mr. J. L. Gill has gone to Kansas City on a short trip.

The Gibson Gas Fixture Company report business exceedingly good, being hardly able to keep up with the orders coming in.

H. Major & Co., electrical engineers and contractors work their force overtime in order to keep up with the orders.

Pedrick & Ayer will soon have on the market a new milling machine, which, it is claimed, will be a great improvement upon those now in use.

Mr. L. Schultz, secretary and treasurer of the Pennsylvania Electrical Engineering Company, has been confined to his room for the past nine days, as a result of too close attention to business.

A change of partnership recently took place in the firm of the Howard Foundry and Machine Works, Mr. J. M. Howard retiring, and Mr. S. Norris Craven being admitted. The firm is now composed of Messrs. E. A. Blanton, Jr., and S. Norris Craven. This new firm will do general machine work, and make a specialty of electric elevators.

The Underwriters' Association of the middle department is sending a notice to all electrical contractors and construction companies installing work in the States of Pennsylvania, New Jersey, Maryland, Delaware and District of Columbia, requesting them to write for agreement form for such work to the secretary of such department at 316 Walnut street, Philadelphia.

N. D. W.

PITTSBURGH NOTES.

PITTSBURG, Oct. 29, 1892.

A Cable Car Accident.—An accident occurred on the Citizens' Traction Company's line in this city yesterday which was rather an unusual one and deserves for that reason to be mentioned. It happened that in some manner the slot rail had become closed, and when a car came along at a more than ordinary speed a concussion occurred at this point, which nearly smashed the entire car and gave the passengers a great shaking up. The slot is presumed to have become closed by a heavy iron wagon—as there are many used here—passing over it. However, this accident suggests the advisability of having the slot rail examined with the same critical eye with which the cable car companies have the cable inspected.

An Insulator Pin Factory.—One of the latest additions to the many industrial establishments of Western Pennsylvania is the factory of the Pittsburgh Insulator Pin and Bracket Company. This company has an office at 54 Bluff street, Pittsburgh, but the works are located at Meyersdale, on the Baltimore & Ohio Railroad. The company is engaged in the manufacture of a special kind of pin, which since it has been introduced has found particular favor among telegraph and electric lighting companies. The Pittsburgh pin is so made as to allow the rain dropping on it to flow off easily, and thus greatly increase the perfect insulation of the wires. The company has recently completed its factory, and has now a very fine stock of machinery.

An Important Consolidation.—One of the most important events in local street railway circles has been the reported consolidation of the Federal Street & Pleasant Valley Passenger Railway Company with the Manchester Traction Company. Both of these companies combined control the entire street railway passenger traffic of the city of Allegheny. The Manchester Traction Company owns the following lines: The Western Avenue line, the Pittsburgh & Manchester line, the Rebecca Street & Beaver Avenue line, the Union Passenger Railway Company's line, the Troy Hill line, and the Allegheny Traction Company's line. Their combined tracks cover an area of about 25 miles and they operate about 100 cars. The Pleasant Valley Line owns the Observatory Hill line, the California Avenue line, the East Street line, the Perry Street and Troy Hill line and several other smaller ones not in active operation. The company is not quite so large as the first one and operates about sixty cars. The Manchester company is an electric road operated by the Westinghouse and General Electric Company's systems, while the Pleasant Valley line is entirely operated by the Westinghouse single reduction motors. It might be mentioned in this connection that the Pleasant Valley, realizing the superiority of the Westinghouse motor, recently threw out their entire equipment of another make and substituted the Westinghouse motor. The consolidation of these two companies has been rumored in the two cities for several years. It has been realized for a long time that such an arrangement would be advantageous for both parties if a satisfactory basis of consolidation could be arrived at. All pending difficulties, if there are any, seem to have been overcome now, and the people of Allegheny are congratulating themselves because they anticipate a great improvement in street car service, and the two respective companies are glad of the consolidation because it will give them chances of developing their lines better than they ever had before. Mr. John H. Dalzell is named as president of the consolidated lines, Mr. D F. Henry, general manager and Mr. R. McC. Ramsey, treasurer.

NEW ENGLAND NOTES.

BRANCH OFFICE OF THE ELECTRICAL WORLD,
Room 28, Hathaway Building, 620 Atlantic Ave.,
BOSTON, Mass., Oct. 29, 1892.

Mr. H. H. Brooks, of the American Circular Loom Company, Boston, Mass., is making a trip through the West and Northwest in the interests of his company.

The General Electric Company is building at its works at Lynn an electric locomotive for the Northern Railroad, which will be ready for test in the course of a couple of weeks.

Mr. F. E. Stevens, Treasurer of the Peet Valve Company, informs us that his company will soon be in the market to supply valves of any desired size to electric light stations and street railway companies.

The new pattern building at the River works of the General Electric Company at Lynn has just been completed, and the work of transfering the patterns from the old and cramped quarters is now going on.

Mr. M. S. Starkweather, the manufacturer of the Boston fender, is putting some valuable improvements on his fender, and when it embraces these he claims the most perfect fender ever brought to the attention of street railway managers.

Mr. C. E. Bibber manager Consolidated Electrical Manufacturing Company, Boston, is travelling through the West in the interest of his company, and will visit Chicago, St. Louis, Pittsburgh, Philadelphia and New York before returning home.

Maybin W. Brown & Co. have opened offices at 620 Atlantic avenue, Boston. The new firm has secured the exclusive agency for a number of valuable street railway appliances, and will devote its energies to this line of business with every prospect of success.

The North Shore Traction Company has decided to build a car house, 100 by 300 feet, having a capacity for the storage of at least 100 cars, at Lynn, and it is thought the company will convert the stables, which are located on Western avenue, into repair shops.

The New England Electric Club will hold the second of a series of musical entertainments at the club rooms, 14 Bosworth street, Boston, Mass., on Tuesday evening, Nov. 1. The management promise a good time to all members and their friends attending.

The Salem Board of Aldermen have granted the Lynn & Boston Railroad Company a location for a single trolley line over Loring avenue, from Swampscott line to Lafayette street. The line will be finished, it is expected, by April 1, 1893, thus completing a direct electric line from Salem to Lynn.

The Bradbury Stone Storage Battery Company, of Lowell, Mass., has had a car specially constructed for it by the Ellis Car Company, of Amesbury, Mass. The equipment consists of one 30-h. p. Detroit motor, McGuire trucks. The battery equipment consists of one hundred and forty cells type X, and bears the name "Bradbury Stone Storage Battery Company," in gilt letters. It is fitted with an electric fare register, electric lights and electric call bells, attached to push buttons placed within easy reach of the passengers. A run was made from Dover to Great Falls, "a road that might be noted for it's hills," without a mishap; it climbed the hills swiftly and smoothly and the trip was conceded to be a success in every way.

Exhibits at the Mechanics' Fair.—The exhibits of the following concerns at the Mechanics' Fair, now being held at Boston, are deserving of mention:

Hill, Clark & Co., Boston, exhibit a line of lathes.

The Curtiss Engineering Company is showing its engineering specialties.

Huyett & Smith, Detroit, Mich., are showing an immense blower and fan.

Geo. B. Graur, Lexington, Mass., is exhibiting a neat set of gears for all uses.

The Pitkin Machine Company is displaying shafting, hangers pulleys, and engines.

Chas. A. Schieren & Co. are on hand showing their link, perforated and ordinary electric belts.

The American Tool Company, Boston, Mass., is showing a line of various sizes of lathes.

The Aston Valve Company, Boston, make a handsome exhibit, which includes all its manufactures.

The Elliot Power Brake Company shows an application of its brake on a model electric car. It works to perfection.

The Main Belting Company, Philadelphia, makes a very fine exhibit of its mammoth beltings, and is also showing a line of pulleys.

The Boston Gear Works is showing, in a working model, the various sizes of gears made by that company. The arrangement is unique and interesting.

B. F. Sturtevant & Co., Boston, Mass., are exhibiting their combination engine and dynamo for marine service, besides a line of all sizes of blowers.

Westinghouse, Church, Kerr & Co. exhibit a 250 h. p. compound automatic engine, which is used to furnish the power for the whole building.

The Whittier Machine Company is making a useful exhibit, insomuch as its electric elevator is being used to convey passengers to the different floors on the building.

The Railway Equipment Company, of Chicago, is showing a line of railway specialties. Mr. Chas. E. Rowe, its New England representative, is taking charge of the exhibit.

The Mather Electric Company, Boston, Mass., is furnishing the light and all the electric power used at the fair. It has four 1,000 light and two 400 light machines doing this work.

H. N. Bates & Co. are showing a floor stand and ring oiling bearing, and loose pulley which is to be used at the Haverhill Electric Light Company's station. They also show the application of their friction clutch to shafting.

The Henry C. Hunt Company is showing the belt for which it has received an order from Messrs. Oliver Ames & Son to replace a belt of their own manufacture, which has been running for the last forty years. It is also furnishing the belting for running the dynamos in the building.

The Lockwood Manufacturing Company, of East Boston, is exhibing the Morse rotary engine, which is coupled direct to a blower. In order to illustrate to the public that there is no vibration to this engine it is placed on top of an ordinary table. It occupies about four feet of space, and is admirably adapted for yachts and small isolated plants.

The Electric Heat Alarm Company has its device arranged in a very attractive way, located on machinery floor. Its alarm is attached to the journal bearings of the engine which furnish power for the building. The company proposes inviting the representatives of the various insurance companies and the press to see the practical working of its alarm.

The Geometrical Drill Company's display, of 105 Summer street, Boston, Mass., is always surrounded by an inquiring crowd, and seems to be getting more attention than any other exhibit in Machinery Hall. This is probably accounted for from the extremely novel nature of its exhibit. It is showing a drilling machine that is capable of drilling any description of hole desired, square or hexagonal. W. R. W.

WESTERN NOTES.

Branch Office of The Electrical World,
465 The Rookery, Chicago, Oct. 29, 1892.

Mr. William A. Ross, Maryville, Mo., is looking for parties willing to install electrical mining machinery and develop a silver mine.

Mr. Clarence A. Ross, the Kansas City representative of the General Electric Company, was in Chicago on Saturday of this week.

Mr. E. C. Ackerman, eastern sales agent of the American Electrical works, Providence, R. I., called on his many friends in Chicago this week.

Mr. F. E. Drake, the general sales agent of the Standard Electric Company, returned to Chicago after visiting New York, Baltimore and other eastern cities.

Mr. F. G. Daniell, the electrical engineer of the Evansville Street Railroad Company, Evansville, Ind., was in Chicago last week securing supplies for his road.

Mr. D. T. Williams, of the Lunkenheimer Brass Manufacturing Company, Cincinnati, O., while en route to Minneapolis, called on his Chicago friends this week.

The Philadelphia Trolley.—The Western Agency for this trolley has been placed with Taylor, Goodhue & Ames, 827 Monadnock Block, Chicago. The trolley is highly spoken of by railway men.

Mr. W. J. Buckley, of the Chicago office of the Fort Wayne Electric Company, has had the good fortune to close the contract for the Kansas City, Kan., electric lighting plant at the nice figure of $196,700.

The Standard Electric Company, Chicago, has moved into its elegant new offices in the Home Insurance Building, corner La Salle and Adams streets, where they will welcome all their friends when in the city.

Mr. B. E. Davis, the traveling representative of Pass & Seymour, the well known manufacturers of electrical specialties and "Syracuse china," of Syracuse, N. Y., has been calling on the electrical trade in Chicago this week, and has secured several nice orders.

The Burton Electric Car Heater.—Taylor, Goodhue & Ames, 827 Monadnock Block, Chicago, have been appointed general selling agents for the Burton Company, and will control the output of the Burton factory. The Burton heater has a record that all connected with it may feel proud of.

Mr. H. K. Merker of Cleveland, has just completed an ingenious clockwork nickel-in-the-slot device, whereby one can automatically obtain five cents worth of electricity from a medical coil inclosed in the machine, and which can only be operated—sixty seconds at a time—by the means of a nickel dropped in the slot.

The Electric Appliance Company has just patented and is placing on the market a new expanding wire guard to be known as the Acme. It is claimed to be a decided improvement on anything heretofore attempted in this line, both in appearance and adaptability, and promises to find a ready sale; in fact the Electric Appliance Company has already booked large orders from different parts of the country.

The Chicago Incandescent Lamp Company, 75 North Clinton street, Chicago, is in receipt of a letter from Mr. Isaac R. Scott, superintendent of the Skenandoa Cotton Company, Utica, N. Y., stating that a group of Pray lamps has been burning for 14,459 hours and "look just as well as when they were first put up." It is worthy of note that six of these lamps were placed on the mill circuit on July 12, 1888, and have been continued in service ever since, burning 23 hours for five days in the week, and 17 hours on Saturday, an accurate record of each lamp being kept. The filament in these lamps is the invention of Thomas Pray, Jr., and is remarkable for its toughness. A copy of Mr. Scott's letter will be sent to any interested party.

Mr. Lou E. Myers, the well known special agent of the Detroit Electrical Works at Chicago, recently wrote to one of the electrical manufacturing companies of Germany regarding an exhibit of its specialties at the World's Columbian Exposition. He was not a little amused to receive a postal card containing the following clear and intelligent reply: "In reply to your favor of 21st inst., we communicate you, that we differ in our arrangement to the exposition of Chicago. Maybe we do generally not send our manufactures to Chicago. We are your esteemed servants, Actien-Gesellschaft von Shäeffer & Walcker, Berlin, S. W." Speaking of the postal, Mr. Myers says: "When I stop to note the sense of the postal card, I wonder what the writer looks like!"

Mr. F. S. Terry, manager of the Electrical Supply Company, last week made one of his flying trips to the East, remaining in New York but one day, but while there he made a new arrangement with the Crocker-Wheeler Electric Company, whereby the Supply Company will have closer relations with the Crocker-Wheeler Company than previously existed, and will handle its motors on a more extensive scale. This was Mr. Terry's first visit at the factory, and he was much impressed with the superior facilities for manufacturing and the great care taken in every part of the manufacture to produce motors of the highest possible type. The motor generator or direct current transformer, which the Crocker-Wheeler Company has recently commenced to manufacture, is in such demand that it may shortly equal in volume of business the sales of the standard motor.

Mr. C. L. Reimann, the new president of the recently re-organized Mosher Electric Company, of Chicago, was a pioneer in the introduction in this country of nickel plating by electricity. In the year 1869, at Newark, N. J., Mr. Reimann first began electro-nickel plating, using primary batteries for the purpose. It was necessary to run from 4 A. M. until 9 P. M. Two different batteries were therefore required, one running from 4 A. M. until the middle of the day, and the other from the middle of the afternoon until 9 at night. Of course the use of primary batteries made the electro-plating expensive, but afterward, when the dynamo came along, this objection was overcome. Mr. Reimann subsequently moved to Chicago and purchased the Chicago Nickel Works, which he has ever since run very successfully, and with profit to himself and those associated with him. Most of the large houses for which nickel plating was formerly done now do their own nickel plating work, and like the shrewd and broad based business man he is, Mr. Reimann has sought other worlds to conquer. He is the president of the Hotel and Car Range Company, and also manufactures a number of fittings and appliances of different kinds. For two years he has had an opportunity of watching the Mosher arc lamp, which was manufactured by his company for the Mosher Arc Lamp Company, and so impressed was he with its merits and the future there was before it, that he, with Mr. J. A. Sheriff, secretary and treasurer of the Chicago Nickel Works, and another purchased the entire stock of the Mosher Arc Lamp Company, and reorganized it into the Mosher Electric Company, giving Mr. Mosher an interest in the Company and retaining his services as electrician and superintendent of the company's factory. The gratifying success of the company since its reorganization augurs well for the future, and Messrs. Reimann, Sheriffs and Mosher have the best wishes of the trade in the West in their new departure. F. de L.

Tacoma, Wash., Oct. 23.

The Government telegraph line between Port Angeles and Port Crescent, Wash., has been removed from the beach to the county road.

The Tacoma Hotel Company has just increased its light and power plant by the addition of a large boiler, and has remodeled the power house.

Contractors Chafley & Tattrie, of Seattle, recently completed a fine piece of street railway construction for the Rainier Power and Railway Company.

It is not unlikely that the Northern Pacific Railroad Company will soon own and operate an electric light plant, which will be used to light the company's numerous terminal and other buildings in Tacoma.

The Seattle Railway and Terminal Company's electric line is involved by the assignment recently made by that company, whose principal business was that of conducting a wheat elevato which proved unprofitable.

The Consolidated Electric Railway Company, of Seattle, has made a proposition to the City Council to pay $50 per month, and after the first year $1 per month per 1,000 population, in lieu of fulfilling the condition of its franchise requiring it to light the streets along its lines.

East Side Electric Line, of Portland, Ore., which is building from Portland to Oregon City, has reached the Clackamas River, near the latter town, and will be completed in December. A large amount of trestle work is yet to be constructed, in addition to a bridge of 200 feet span.

Chas. S. Bowie, manager of the Northwest Electric Supply Company, recently installed an Edison incandescent plant of fifty lights capacity in the Puget Sound Shingle Company's mill, and a similar plant, having a capacity of thirty lights, in the Mt. Tacoma Lumber Company's mill.

Manager A. J. Clark, of the Sunset Telegraph and Telephone Company, in Seattle, has closed up agreements with about 68 subscribers in Everett, Wash., and will proceed to put in an exchange at once. Contracts have been let for poles, etc., and about 40 miles of wire will be put up as soon as possible.

W. S. Boyd, formerly of Chicago, and for some time Puget Sound representative of the Pacific Phonograph Company, had a number of phonographs in use at the Western Washington Industrial Exposition in Tacoma. Mr. Boyd will return to Chicago to engage in a different branch of electrical business.

The Union Electric Company, of Seattle, will at once extend its incandescent circuits to the suburb of Fremont to supply residence lighting. Four and one-half miles of new wire will be required. In accordance with a contract with the city the extension into Brooklyn and Latona will soon be completed.

J. P. F. Kuhlmann, the engineer who invented a counterbalance system which he constructed for the Rainier Avenue Electric Railway, of Seattle, and also for a street railway in San Francisco, has been allowed a patent for the contrivance, which has proved very useful on electric roads having heavy grades.

The Northwest General Electric Company has concluded an examination, through one of its electrical engineers, of the electric light installation on the Canadian Pacific Railway Company's steamship Empress of India, which will probably result in a contract to re-wire the vessel, as the plant shows some deterioration.

An experimental line is to be constructed in Tacoma of L. F. Cook's elevated electric railroad system, on which patents have been obtained. An ingenious traction device, economy of space and the overhead construction are the best features of the system. Bids have been called for for the construction of about 1,000 feet of line in an oval shape.

The Western Union Telegraph Company has almost completed its line from Tacoma to South Bend, Wash. A new line is in course of construction from Tacoma to Olympia. Other short lines are likely to be constructed from time to time, but the anticipated absorption of the Postal Telegraph Company's lines in this State may prevent anything extensive in the way of new lines.

Col. J. B. Hawley, president and manager of the Union Electric Railway Company, of Everett, Wash., has returned from New York, where he met Chas. Colby and other interested capitalists, who assured him that all of the capital required would be supplied for the construction and equipment of the electric street railway and electric light systems in Everett. Work will proceed rapidly.

The Sunset Telegraph and Telephone Company has obtained a restraining order to prevent the Northern Pacific Railway from removing the telephone company's poles where they are situated within the railroad company's right of way between Tacoma and Portland. The telephone line follows the county roads, but it appears that the railroad claims jurisdiction wherever it enters its right of way.

The Sunset Telegraph and Telephone Company's line has been completed from Tacoma to Portland, Ore., a distance of about 150 miles. The service given is perfectly satisfactory. A conversation lasting three minutes costs $1.25. By connecting with the Oregon Telephone Company's lines communication has been successfully carried on between Everett, Wash., and Corvallis, Ore., distant about 315 miles.

The Grant Street Electric Railway, Fred E. Sander, president, will start up at its new power house in South Seattle Nov. 1. It will have the most complete power station in the city, the equipment having been installed by the Northwest General Electric Company. Two Thomson-Houston make 90-h. p. generators and one Thomson-Houston 650-light alternator will be driven by three Westinghouse combination engines.

The A. F. Espersen Company, of Tacoma, has moved its offices and supply house to 112 Tenth street. The Arnold Novelty Company has its Tacoma offices at the same location, and reports an increasing demand for the Arnold flexible electric bracket, which is now being manufactured for the company by the general agents, Clark & Marshall, of Chicago. An extensive exhibit of the brackets will be had at the World's Fair.

The Rainier Power and Railway Company, of Seattle, opened its Third street line Oct. 15. A party of officials and invited guests made a special trip to Lake street on the preceding day, the distance being about three miles. The cars will connect at that point with the Lake Union cars of the Seattle Consolidated line until the remainder of the line is opened. The Rainier Power and Railway Company has commenced supplying light and power in the business district.

The following Seattle street railway companies have petitioned the city for extensions of franchises and the release from conditions requiring them to pay the city a percentage of their earnings: The Front Street Cable, Madison Street Cable, Green Lake, Rainier Avenue Electric Union Trunk Line, Rainier Power and Railway, Seattle Electric Railway, West Street & North End, Grant Street Electric, Woodland Park, North Seattle, South Seattle. Bonds held, $2,133,000 in all. G. deV.

CANADIAN NOTES.

Ottawa, Sept. 24, 1892.

Rat Portage, Man.—An electric tramway, connecting Rat Portage with Norman and Keewatin, is proposed and will probably be built next summer.

Mr. J. S. Anderson, manager of the British Columbia Division of the Edison General Electric Company, has resigned, and is succeeded by Mr. Maxwell, of the Portland office.

Amherstburg, Ont.—The ratepayers of this town have accepted the offer of Manager Clark to extend the electric road to Amherstburg and the river front for a bonus of $25,000.

The Vancouver Electric Light and Railway Company has presented a most satisfactory report to its directors, and as a result it has been decided to increase the plant in all its departments.

Victoria, B. C.—The Victoria & Esquimault Telephone Company is remodeling its entire system, an undertaking which will keep a large crowd of men employed for at least four months, and which will involve an outlay of $15,000 or $20,000.

Quebec.—A company has been organized and has applied to the corporation for permission to build an elevated electric street railway here. They ask exemption from taxation for 30 years and a franchise, as conditions of their undertaking the project.

Nanaimo, B. C.—The City Council is negotiating for the purchase of the electric light works. A committee has been appointed to make a thorough inquiry into the operations and financial standing of the company. The price asked is $40,000.

Brantford, Ont.—The Brantford Electric Lighting Company has accepted the city's offer to do the lighting at 23½ cents per light per night, giving 37 lights instead of 30. The company will do the lighting of 30 lamps next year at about $700 less than it did last year.

Woodstock, Ont—A by-law has been passed to be submitted to the electors authorizing an expenditure of $10,000 for better fire protection, including an item of $2,800 for the introduction of an electric fire alarm system, which service is now performed by the Bell Telephone Company.

The C. P. R. Telegraph Department is having a fourth wire strung between Montreal and Vancouver. This became necessary on account of the great increase of business. One wire will be devoted exclusively to the railway service, the others being employed for commercial use.

Carleton, N. B.—The superintendent of the fire alarm system has submitted to the Council several estimates, each of which provides for eight boxes. If the non-interfering signal boxes are used, in connection with a tower striker, a 2,000 pound bell and tower complete on the city hall, the whole apparatus for a first class electric system would cost the sum of $2,825.

Hamilton, Ont.—The electric company, having refused to furnish a declaration as to the accuracy of accounts, the city solicitor gives the opinion "that it was in the discretion of the board of works and the Council to ask that declarations be furnished." A resolution was passed requiring the electric light company to verify all accounts presented for payment by declarations.

Ottawa, Ont.—A number of Ottawa capitalists, including Messrs. Thos. Ahearn, R. Blackburn, Wm. Scott, J. W. McRae, G. P. Brophy, Thomas Workman and Peter Whalen, are seeking incorporation as the "Ahearn Electric Heating and Manufacturing Company, Ltd.," to take hold of Mr. Ahearn's patent and supply heat and light by electricity in all its branches. The capital stock of the proposed company is $250,000.

Montreal.—Notice is given in the Canada *Gazette* of application for letters patent to incorporate the Central Electric Light Company, of Montreal, capital $200,000. The following are the applicants: Louis Perrault, Honore Beaugrand, Treffle Berthiaume, E. M. Lovelace, Odilon Dupuis, Jos. Melancohn, Joseph A. Rodler, Alphonse Raza, Charles Berger, Joseph Brunett, James Cochrane and Emmanuel St. Louis, all of the city of Montreal.

Woodstock, Ont.—The Town Council have come to an agreement with the Bell Telephone Company by which: 1. The night fire alarm is to be given the town free of cost. 2. The telephone company is to pay the town $200 annually for the five years for the streets. 3. The company is to give the town the use of three telephones free of charge. 4. The cost of the telephone service to subscribers is not to be increased above the present rates. This agreement is made for five years and effects a saving to the town annually of $525.

Port Arthur, Ont.—The Dominion government has entered a claim in the Exchequer court against the town of Port Arthur for $1,596, duty on 266 tons of steel rails used in the construction of the electric steel railway of that place. For some time it was a disputed question whether rails used in such railways were dutiable, provided they were of the same weight as those rails used in railroads which were admitted free. The government some time ago decided that all rails used in electric roads, no matter the weight, would be classed as tramway rails and consequently were dutiable.

Toronto.—The several business interests heretofore carried on in Canada by the Edison General Electric Company, the Edison Electric Light Company, the Thomson-Houston International Electric Company and the Toronto Construction and Electrical Supply Company, have been consolidated and will hereafter be conducted by the Canadian General Electric Company, Limited, which company has acquired the Canadian properties, patent rights and good will of the several companies cited above. The authorized capital of the new company is $2,000,000, that subscribed $1,500,000, and the amount paid up is $1,400,000.

Ottawa, Ont.—Some time since the Ottawa Electric Street Railway Company made application to the Ontario government for three small islands, covering an area of 33 acres, lying in the Ottawa river, a short distance from the city, with the intention of running its tracks to the river banks opposite the islands and bridging the latter with the main land, the object being to establish a summer park within easy reach of the city. These islands are of no earthly use for any other purpose, and have remained unoccupied for ages. Yet when it became known that the Ottawa Electric Street Railway saw the possibility of turning these deserted spots in the river to some account, a determined effort was made to run up the price and thwart the company in securing the property if possible. The Ottawa, Ont., City Council propose taxing the company two dollars per car per annum, in direct violation of clause 10 of the company's contract with the city, which exempts the company from all municipal tax upon property connected with the road.

ENGLISH NOTES.

(From Our Own Correspondent.)

LONDON, Oct. 19, 1892.

South Staffordshire Tramways.—It is anticipated that the first fourteen electric cars will be running on a section of this company's system about the beginning of November.

Electric Lighting Orders.—During the 12 months ending June 30, 1892, 32 electric lighting orders were applied for, of which 25 were granted, 17 to local authorities and 8 to companies. There are at present no less than 116 local authorities in possession of electric lighting powers and 61 companies.

The Electrical Manufacturing Industry.—The six per cent. dividend recently declared by the Brush Electrical Engineering Company has attracted considerable attention, but apparently it does not enable the electrical manufacturing firms of good standing to raise money on easy terms. Only a short time ago a leading electrical firm in this country was obliged to raise additional capital by the issue of seven per cent. cumulative preferred shares.

Bradford Municipal Station.—Another half yearly financial account of this station has recently been rendered by the electricity department of the Town Council. A trade profit of close upon £400 was announced for the half year ending June 30. It may be worth while perhaps to point out that although this station is now and has for some little time been making a profit, it is still £800 in debt owing to the large amounts which have had to be set aside from the beginning for interest and sinking fund. The total amount spent up to date upon the Bradford station is £48,000.

Electric Miners' Lamps.—The *Times*, commenting on a recent colliery accident, ventured a few days ago to recommend that the "Davy" lamp should be superseded by an electric lamp. Upon this a sapient correspondent observed that, although the lamp would burn safely in an explosive atmosphere, its substitution for the Davy lamp would have the serious drawbacks that no notice of the presence of choke damp would be given to the miner; forgetful, or perhaps ignorant of the fact that several ingenious electric lamps have been devised which give warning of the approach of foul air quite as soon and quite as surely as the old "Davy" lamp.

Electrical Resistance and Magnetic Susceptibility at Low Temperatures.—The investigations of Profs. Dewar and Fleming upon the electrical resistance of metals at very low temperatures has, as was to be expected, aroused considerable attention in scientific circles. Dr John Hopkinson points out that it has been observed in the case of iron and nickel that the temperature coefficients are much greater below the temperature at which these substances change from the magnetic into the non-magnetic condition than above that temperature, the coefficients in the case of iron being respectively .019 and .007. He is of opinion, therefore, that any such change occurring in copper, platinum, gold silver or aluminium at the lowest temperature observed by Profs. Dewar and Fleming would have been detected if these metals had been cooled sufficiently to become magnetic.

Electro-Pneumatic Transmission.—I hear that the company initiated some years ago by M. Victor Popp in Paris for the distribution of light and power by a combination of pneumatic and electric transmission, has at last come to grief. It has long been anticipated that this would be the case, owing to the extreme wastefulness and large prime outlay involved in M. Popp's method of working I do not know whether the original mode of working was continued to the bitter end, but at any rate a few years ago M. Popp sent compressed air from a central station to sub-stations, where air engines drove dynamos, which charged accumulators, which supplied the lamps with current. A very high price was charged for the compressed air for air motors, and it was said that the only reason which induced people to make use of the air motors was that the exhaust was very useful for the purpose of cooling storage cellars, so that in spite of its expensiveness M. Popp's system found a large *clientèle* among butchers, poulterers, fishmongers, fruiterers, etc.

Accumulator Traction.—There can be but little doubt that the use of storage batteries for private installations received a considerable impulse by the adoption by battery manufacturers of the system of undertaking the maintenance and entire charge of the cells for a certain annual percentage of their original cost. Similar offers, however, in regard to batteries for traction purposes have not as yet appreciably forwarded their use in this direction. I mentioned some little time ago, however, that the comparative failure of the cars belonging to the Birmingham Central Tramway s Company had resulted in a firm of good standing coming forward and offering to maintain the cells in working order for a certain fixed sum. Within the past few days the Electric Power Storage Company has issued a circular to the chief tramway companies of Great Britain, offering to maintain batteries in working order, to pay for drivers, conductors, engineering staff, coals, steam engines, dynamo, motor and gear repairs upon the basis of a *maximum* annual charge of 66 per cent. of the gross receipts, a lesser sum being charged where the system is an extensive one. This offer should stimulate battery traction if anything short of gratuitously running the cars can infuse life into this system.

Underground Mains in Paris.—All the varieties of underground mains employed by the Paris electricity supply companies appear to have given their owners considerable more trouble than has been the case in London. In many cases the French engineers seem to have a rooted dislike to plain, straightforward engineering types. Insulated cables imbedded in wooden blocks treated with paraffine or with sulphate of copper, the whole being placed in iron or cement troughs, have obtained considerable favor. Lead covered and concentric cables laid in sand are but little used, and rubber insulated cables drawn into wrought iron pipes (so common in London) have in no case been adopted in Paris. The type of main, however, which apparently has obtained most favor, and which certainly has given the most trouble, is a modification of the Crompton conduit, viz.: bare copper strip laid in stoneware conduits. This system had not long been in operation before the Edison company began to repent having adopted it. The stoneware, though perhaps cheap, was decidedly porous. The water percolated into the conduits: the insulations of the mains soon became a negligible quantity and all manner of electrolytic processes began to take place, ending in explosions. In some cases massive copper conductors have been eaten right through, apparently by some such gas as nascent chlorine, but in the generality of instances on opening the conduit after an explosion it has usually been full of a mass of soda and potash salts mixed with traces of lead or iron. Careful investigation of the neighboring gas mains has almost invariably shown that these latter have been pitted and perforated, the high temperature of the surrounding soil pointing to powerful electrolysis. I understand, however, that the Edison company has adopted measures with a view of completely remedying these defects. The stoneware is being replaced by cement and more attention is being paid to the insulation of the copper strips.

News of the Week.

THE ELECTRIC LIGHT.

Boonsboro, Md., is anxious to secure an electric light plant.

San Pedro, Cal., is taking steps to secure an electric light plant and water-works.

Decatur, Ill.—J. H. Culver, E. E. Gibson and J. M. Willard have asked the City Council for a franchise to establish a lighting and heating plant.

Kokomo, Ind., has settled the electric light question by granting a franchise to the Western Electric Company, for the illumination of its streets.

Tecumseh, Mich., has let the contract for electric lighting to the Fort Wayne Electric Light Company, and it is expected that the plant will be in operation within five weeks.

The Howe Electric Construction Company, of Norwalk O., has closed a contract with the Newark & Grandville Electric Light Company, of Newark, O., for an incandescent plant, consisting of one Heisler dynamo with a capacity of 450 32 c. p. lights and all the necessary apparatus.

The Brush Electric Company, of Cleveland, is very proud of its new incandescent machine. It has just shipped to the Roaring Fork Electric Light Company, of Aspen, Colo., a 1,500-light incandescent dynamo that both for compactness and efficiency seems to be an important step in advance. This machine is wound for 140 volts, and though it is rated at 1,500 lights—and in reality has a considerably greater capacity—weighs but 12,000 pounds. Mr. S. M. Hamill, the secretary and general manager of the Brush Company, does considerable traveling for the company, and generally closes a good sized contract or two every time he goes away. Mr. Le Vake, the assistant secretary, pays close attention to the filling of the large and increasing number of orders after they are secured.

THE ELECTRIC RAILWAY.

Memphis, Tenn.—The East End Dummy Line will probably change its motive power to electricity. The company is improving its roadway, laying new rails, etc.

Indianapolis, Ind.—A meeting of South Side citizens was recently held to take steps toward securing an electric line for that part of the city. A committee was appointed to wait upon the president of the Citizens' Street Railway Company.

The Port Arthur (Ont.) Electric Railway Company contemplates extending its road about five miles through two other towns and is ready to receive bids on the equipment.

The Washington (D. C.) & Arlington Railway Company recently gave a complimentary excursion to a party of friends over the completed portion of the railway running from the southern end of the Aqueduct bridge to Arlington cemetery. A number of the most prominent Washington business men, and particularly those connected with street railway enterprises, were present.

LEGAL NOTES.

The Supreme Court of New York rules that machinery placed by an electric light company in a building erected by it on leased land does not become part of the realty, and may be removed on execution by a creditor of the company. Havens v. West Side Electric Company, 17 New York Supplement, 580.

The Supreme Court of Indiana holds that in an action by a subscriber to a bonus to be paid a company for moving its manufactory to plaintiff's town, for failure to do so, the measure of damages, in the absence of allegations of special damage, was the amount of the subscription, together with interest from the date of the payment. Fort Wayne Electric Light Company v. Miller, 30 Northeastern Rep., 23.

The Texas Court of Appeals rules that where the contents of a telegram were disclosed by the agent who received it, the sender was entitled to damages sustained thereby, notwithstanding his failure to comply with a stipulation by presenting a claim therefor within 60 days, the disclosure having been fraudulently concealed until after the expiration of such time, and then discovered by accident. Gulf Coast & S. F. Ry. *v.* Todd. 19 Southeastern Rept., 761.

Electric Light Companies.—The Supreme Court of Kansas holds that an electric light company which has a franchise to occupy the streets of a city with its poles, wires and lamps, and is engaged in furnishing light to the people of the city, is not so distinctively public in its nature and operations as to exempt its property from the application of the mechanic's lien statute. (Badger Lumber Co. v. Marion Water Supply, Electric Light and Power Co., 30 Pacific Rep., 117).

In New York the Supreme Court rules that under Laws 1890, c. 542, secs. 3, 11, as amended by Laws 1885, c. 501, providing that every domestic corporation shall pay an annual tax upon the value of its capital stock employed within this State, an electric light company, conveying to various companies outside the State the right to use its patents, and receiving payment therefor in the stock of such companies, is a mere investor in this stock, and the capital thus invested is not exempt. (People v. Wemple, 18 New York Supplement, 511).

Electric Street Railways.—In Massachusetts plaintiff's intestate stepped from an open car before it had stopped, and was struck and killed by an electric car coming from the opposite direction upon a parallel track. When he rose to leave, the dashers of the two cars were opposite each other, the car which struck him was going at the rate of fifteen miles an hour, its gong was sounding, and there was nothing to prevent the intestate from seeing and hearing it. Before he left the car the conductor and a passenger both shouted to him to stop. Supreme Court held that a verdict was properly directed for defendant. (Creamer v. West End Street Ry. Co., 31 Northeastern Rep., 391).

In Indiana, a manufacturing company having offered to remove its plant to another town, a committee of the inhabitants was appointed to investigate its financial standing, but on the plea of expense in taking an invoice during the busy season, the directors executed a guaranty that an invoice would show a certain standing "on April 1, 1888" (a future date). It was held by the Supreme Court that this implied a promise to take an invoice showing the condition on that date within a reasonable time, and a failure to do so was a breach of the contract. The court also decided that as tending to show what would be a reasonable time, it was competent to prove what was said by the directors at the time of making the guaranty, as to when it would be practicable and convenient to make the invoice mentioned. (Fort Wayne Electric Light Co. v. Miller, 30 Northwestern Rept. 23.)

Telephone Companies.—In Montana, a petition to enjoin defendants from erecting telephone poles in a street alleged that plaintiffs' predecessors in interest (who were the original occupants in a government town site of certain lots fronting on M street, which were subsequently conveyed to them by the town site trustee), "since the entry of said town site," and while they were the owners and possessed of the premises, cut off from their "lot 10 feet in front thereof and adjacent to M street," for a street for the benefit of their property. The Supreme Court of the State held that the complaint did not warrant the assumption that plaintiffs' predecessors ever obtained title in fee to the 10 feet cut off, there being no allegation showing that such cut-off was made after the conveyance to them by the trustee, and did not show any additional easement placed on plaintiffs' property. (Hershfield v. Rocky Mt. Bell Tel. Co., 29 Pacific Rep., 883).

A contract between a telegraph company and a business firm recited that, in consideration of the surrender by the firm of a valuable existing telegraphic contract, it should have the privilege of putting up, at its own expense, on the poles of the company, a wire between New York and Philadelphia, for its own use and that of its licensees, not exceeding four in number, such licensees not to be telegraph or railroad companies, bankers, or stock or exchange brokers; that, in consideration of being allowed to use the wire when not in use by the firm or its licensees, the company would keep it in working order free of charge; that on the expiration of 10 years the wire should become the property of the company; and that thereafter the company would lease it to the firm "for $600 per annum, payable quarterly," "upon the same terms in all other respects as if the wire had not been given up;" and that no assignment by the firm of their rights under the contract should give their assignees the right to demand a lease of the wire after the expiration of the 10 years. The Supreme Court of the United States held, that the contract, after the expiration of that time, was not terminable by the company at the end of any year, but gave the firm an absolute right, on paying the yearly rental, to use the wire so long as the company should maintain a telegraph line between the two cities, Mr. Chief Justice Fuller and Mr. Justice Brewer dissenting. (Franklin Telegraph Co. v. Harrison, 12 Supreme Court Rept., 900).

MISCELLANEOUS NOTES.

An Electric Club has been organized in St. Paul, Minn., with the following officers: Geo. I. Burns, president; H. B. Farrington, vice-president; A. H. Savage, secretary and treasurer.

The Edison General Electric Light Company has begun suit against the Sawyer-Mann Company to compel the latter to render an account of the moneys that accrued to it from the manufacture of incandescent lamps.

Mr. Zenas King, president of the King Iron Bridge Company, died at his home in Cleveland on Oct. 26. Since 1856 Mr. King had been in the business of building bridges. His two sons, James A. King and Harry W. King, who have been identified with the King Bridge Company for many years, will continue the business.

All in the Name.—Mr. C. E. Bibber, of the Consolidated Manufacturing Company of Boston, distributed at the recent Street Railway Convention a little pamphlet regarding the Lyon Brake. The heading of the circular was About Brakes, and a wag suggested to Mr. Bibber that it should be changed so as to read Lyin' About Brakes.

Electricity at the University of Minnesota.—Prof. George D. Shepardson, of the electrical department of the University of Minnesota reports that the new year has opened with a very largely increased attendance over that of last year. About 30 freshmen have registered in the electrical engineering course alone and other classes have increased proportionately. The department is preparing for some interesting investigations in the laboratory.

Electrical Union No. 5,468, American Federation of Labor, has declared war against the Electrical Contractors' Association, and acting under the instruction of its walking delegates about 400 men have gone out on a strike. A number of electrical firms in New York are involved, but it is thought that their work will not be seriously interfered with. The strike was caused by the decision of the contractors not to discriminate between union and non-union men.

A certificate of consolidation of the Eickemeyer-Field Company, the Eickemeyer Dynamo Machine Company, and the Yonkers Machine Company, under the name of the Eickemeyer-Field Manufacturing Company, has been filed with the Secretary of State. The company has a capital of $1,000,000, and will construct power

and electric light plants and manufacture electric railroad equipments at Yonkers. The directors are Rudolf Eickemeyer, Henry Osterheld, Stephen D. Field, Norton P. Otis and William D. Baldin, of Yonkers, and E. E. Nichols and Samuel Shethar, of New York City.

Mr. Edison and His Marriage.—An amusing dispatch from Paris published in the Sunday New York papers says that the *Petite Electricien Illustre* of Paris asserts that Edison's powers have totally declined since his marriage, that the Menlo Laboratory has been abolished, and that Edison's supporters have stopped the supplies. Madame Gouraud, having had her attention called to the article Friday, issued a denial of these statements. Madame Gouraud shows that Edison has produced many marvelous inventions since his marriage, and that Menlo Park Laboratory continues active. Nevertheless, it is difficult to convince the cynical Frenchmen, who would like to make a point against marriage, even at the expense of Edison's reputation.

The Universal Electric Company, of Cleveland, the new manufacturing company recently organized by N. S. Possons, W. J. Possons and Geo. R. Lean, is starting in business with an apparent determination to succeed. The company has hired an entire building, and in addition to repairing or rejuvenating burned out incandescent lamps, will manufacture pure tempered copper and also a number of electrical specialties. Mr. N. S. Possons was for a long time the superintendent of the Brush Electric Works, where he did some excellent work. This position he resigned to accept a very flattering offer from another company. Of late he has had considerable experience with tempered copper, and says he will soon have something in that line to show electricians that will attract general attention. It will be practically absolutely pure. His brother, Mr. W. J. Possons, has had a wide practical experience in the electrical field, while the other member of the triumvirate, Mr. Lean, is also thoroughly well known in electrical circles, having been for years connected with the Bernstein Electric Company of Boston. All who know the Messrs. Posson and Mr. Lean wish them abundant success.

Industrial and Trade Notes.

The Tea Tray Company, 156-158 Summer street, Newark, N. J., manufacturers of shades and metal specialties, is crowded with orders, and its shops are running at full capacity.

The United States Typewriting Headquarters, 787 Broad street, Newark, N. J., reports business very active. This company makes a specialty of supplies for the electrical field and has met with very encouraging success.

Truex & Vail, 136 Liberty street, New York City, manufacturers of swinging ball lightning arresters, report that they are crowded with orders. The American Visual Telegraph Company, which this company handles, is meeting with marked success.

The Nutting Arc Lamp for Incandescent, Railway and Arc Circuits.—Taylor, Goodhue & Ames, general selling agents for the Nutting factory, placed an order last week for one thousand lamps for incandescent circuits, which is probably one of the largest orders for this kind of lamp ever placed.

The Watts-Campbell Company, Newark, N. J., reports that it is very busy. Its shops are run until 10 P. M., with the exception of Saturday. Among the contracts which this company has recently received are the following: New York *Herald's* new building, 4 engines; Stern Bros., Twenty-third street, 2 large engines; besides very large contracts in Philadelphia, Fall River and other places.

The Akron Electric Company, of Akron, O., of which Mr. H. R. Palmer is superintendent, seems to be meeting with the most gratifying success with its now well known dynamos and motors. The company has recently sold a 200-light dynamo to the Franciscoli Hotel, of Memphis, Tenn.; a 200-light dynamo to Hess, Snyder & Co., of Massillon, O.; a 75-light dynamo to Baker, McMillan & Co., Akron, and a 75-light plant to E. H. Merrill & Co., Akron, besides an electric elevator outfit to Akers, Harphan & Co., of Akron.

The Lodge & Shipley Machine Tool Company, of Cincinnati, O., exhibited one of its motor gear lathes at the recent convention of the National Street Railway Association, at Cleveland. The lathe attracted considerable attention and accomplished the remarkable performance of turning, boring and squaring a motor gear 23 inches in diameter, 4½ inches face and 3⅝ inches bore in 17 minutes. This machine is meeting with general favor, not only for motor gear work, but for general machine work.

The United Charities Building, corner of Twenty-second Street and Fourth avenue, New York, is approaching completion, and it will not be long before it is ready for occupancy. The Ball & Wood Company has recently put into this building two of its 100-h. p. and one its 60-h. p. engines. The Lexington Avenue Opera House will also be lighted by the Ball & Wood engines, one 175-h. p. and one 50-h. p. having been furnished for this purpose. Frederick Loeser & Co., of Brooklyn, are putting in two 60-h. p. and one 130-h. p. Ball & Wood engines. The Bridgeport Electric Light Company is just installing four 100-h. p. tandem compound Ball & Wood engines, and Mr. English is making rapid progress with his new plant.

The American Electric Supply Company, 226 Pearl street, Buffalo, N. Y., has recently made a change in its officers, which are now as follows: President, C. M. Underhill; vice-president, T. C. Ransom; treasurer, C. M. Ransom; secretary, I. F. Underhill; general manager, W. A. Fenn. The company is in excellent working order and among the many contracts for complete systems of interior wiring for electric light work, with the brass armored conduit of the Interior Conduit Company, may be mentioned the following: D. H. Destiack, 275 lights; Dr. J. T. Cook, 150 lights; the Newmarket Arcade, 475 lights; Parke's Sash and Door Works, a 200-light isolated plant; all of Buffalo. W. J. Schoopflenn & Sons, Gardenville, N. Y., 150-light isolated plant with C. & C. dynamos; Erie County Bank, an electric light plant. The company is also installing in this bank a complete telephone duplicate district messenger call system, which will require over 22 miles of Okonite wire.

The Ball Engine Company, of Erie, Pa., reports that it is having the largest amount of business in the history of its existence, and has enough orders to carry it well through the winter. Among some of the recent orders are the following: Brockton Street Railway Company, Brockton, Mass., one 600-h. p. cross compound; Calumet Street Railway Company, Chicago, Ill., four 300-h. p. cross compounds; San Leandro Street Railway Company, San Francisco, one 500-h. p. tandem compound; East Oakland Street Railway Company, San Francisco, one 400-h. p. tandem compound; Englewood Electric Light Company, Chicago, Ill., one 600-h. p. cross compound; Binghamton Electric Light Company, Binghamton N. Y., two 250-h. p. tandem compound; Wheeling Street Railway Company, Wheeling, W. Va., three 250-h. p. cross compound; Pottstown Electric Light Company, Pottstown, Pa., one 250-h. p. cross compound; Erie Electric Motor Company, Erie, Pa., three 150-h. p. tandem compounds.

The "C. & C." Electric Motor Company, 402 and 404 Greenwich street, New York City, report the following recent sales through its New York, Chicago and Boston offices: Menominee Electrical and Mechanical Company, Menominee, Mich., a 15 h. p. and a 3½ h. p. motor; a 6, 4 and 3 k. w. dynamo; Baydenoquet Company, Nahma, Mich., a 12 k. w. dynamo; Armour Packing Company, a 25 h. p. and two 5 h. p. motors; De La Vergne Refrigerating and Machine Company, this city, a 15 h. p. motor; Laclede Power Company, St. Louis, Mo., three 25 h. p. and two 10 h. p. motors; Heidt & Son, Jersey City, N. J., a 20 h. p. motor; H. R. Worthington, Brooklyn, N. Y., 10 and 3 h. p. motor; Harvey Street Car Works' Harvey, Ill., a 30 k. w., plant including lights and installation; Midvale Steel Company, Nicetown, Philadelphia, Pa., an 80 k. w. dynamo and Ball engine, including installation; Boston & Maine Elevator (Messrs. Simpson & Robinson), Charlestown, Mass., 20 k. w. dynamo, lamps and installation; Home for Paupers, Long Island, Boston Harbor, three 12 k. w. dynamos, three 5 h. p. and two 2 h. p. motors; the C. & C. Company has also orders filled and unfilled from a single crane company for over fifty machines consisting of one 20-h. p., nineteen 16 h. p., thirteen 12 h. p. and nine 8 h. p. motors, the balance being in sizes below 8 h. p.

Business Notices.

Transformers rewound and repaired. Write for prices. The Hill Manufacturing Company, Salem, Va.

Battery Cut-Out, Cheap.—Sensitive, reliable, never requires attention. Gas lighting much improved by its use. Electric Supply Company, of 105 South Warren street, Syracuse, N. Y.

Are You With Us?—We defy any oil saving or purifying device manufacturers to produce an apparatus that can compete with the Ideal Steam Oil Refiner, made by the Purity Oil Filter Manufacturing Company, 900 Water street, Pittsburgh, Pa.

OUR ILLUSTRATED RECORD OF ELECTRICAL PATENTS.

[In Charge of W. A. Rosenbaum, 177 Times Bldg., N. Y.]

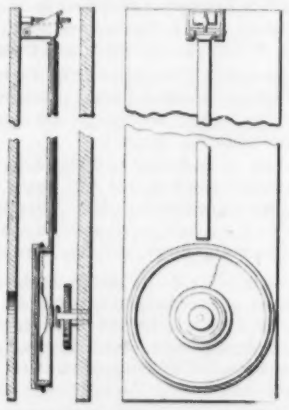
U. S. PATENTS ISSUED OCT. 25, 1892.

484,778. Telephonic Transmitter; A. T. Collier, St. Albans' Eng. Application filed Dec. 8, 1891. In a telephonic receiver the combination with the diaphragm secured upon an annular framing suspended upon a rod depending from a support pivoted to the frame of the transmitter and having an inclined plane on its upper side, of the wing nut and screw whereby the said rod may be adjusted to adjust the diaphragm and its electrode with respect to the back electrode.

484,785. Magneto Electric Generator; S. Evershed, London, England. Application filed Jan. 8, 1892. A portable or magneto-electric generator consisting of an armature having a core, closely fitting pole pieces energized by permanent magnets; said armature core having holes therethrough parallel to the axes and narrow slots extending from periphery to the said holes to effect the winding of the coils, the said coils being connected up independently to as many two-part commutators as there are coils and brushes rubbing on the said commutators to connect the said armature coils in series and with the terminals of the generator.

484,825. Incandescent Lamp; F. S. Smith, Pittsburgh, Pa. Application filed Feb. 29, 1892. An incandescent lamp consisting of a filament and an inclosing chamber consisting in part of glass and in part of a soluble substance.

84,842. Wire Coupling; W. E. Banta, Springfield, O. Application filed July 1, 1892. In a wire coupling, the combination, with the ends of the line wires bent outwardly, of a connector or coupling composed of encircling coiled wires joined together and adapted to bite into said line wires under the coupling strain.



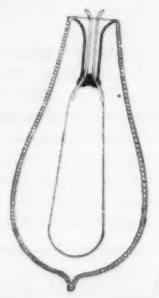
No. 484,778—Telephonic Transmitter.

484,865. Automatic Cut-Out; C. E. Sanford, Brooklyn, N. Y. Application filed May 7, 1890. A self-protecting telephone and telegraph instrument protector, which consists of three or more electromagnets, the helices of which respectively vary in resistance in prescribed degrees and are connected in series in the main circuit, which includes the telephone or telegraph instrument to be protected, a number of normally open branch circuits to the ground or shunts around the telephone on other instrument to be protected, equaling the number of electromagnets employed and a like number of armatures for respectively closing said branch or shunt circuits successively when the helices of the magnet become charged with abnormal currents of prescribed strength.

484,877. Process of Separating Iron from Ore; H. H. Eames, Baltimore County, Md. Application filed April 6, 1889. The method or process of extracting iron from gangues, ores or sponges containing it by grinding or otherwise dividing the material and bringing the same in contact with or proximity to a conductor through which a current of electricity is passing, whereby the iron particles therein are caused to adhere to the conductor.

484,911. Ceiling Block; J. J. Green, Boonton, N. J. Application filed May 17, 1892. In a fuseblock for electric wires, the combination of the hollow case inclosing the terminals of the main wires, the cap fitted thereto carrying the terminals of the consumption wires, the compressible packing inserted between said base and cap, the interlocking projections between said base and cap for securing them together, and the interlocking terminals of the main and consumption wires, whereby the electric circuit is completed by the act of rotating the cap laterally into position to compress the packing.

484,919. Electric Railway System; J. H. Pendleton, Brooklyn, N. Y. Application filed Aug. 1, 1891. In an electric railway system, a supply conductor, a sectional working conductor, interposed energizing sections, a primary branch for each section of the working conductor leading from the supply conductor and including an electromagnet, and a secondary branch for each energizing section, the coil of the electromagnet being included in both branches.



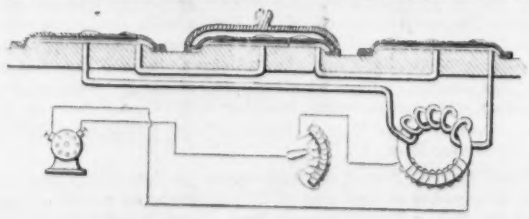
No. 484,825—Incandescent Lamp.

484,924. Closed Conduit for Electric Railways; B. F. Sutton, Brooklyn, N. Y. Application filed July 7, 1891. The combination with an inclosing tube of flexible insulating material of a main conductor extending along the inner wall of the tube, a series of conducting plates extending along the interior of the tube opposite the main conductor, and a second series of conducting plates extending along the exterior of the tube and electrically connected with the series extending along the interior, the plates of said series being arranged to alternately overlap the portion of the tube intervening between two successive ends of the plates.

484,959. Electric Converter; L. Gutmann, Fort Wayne, Ind. Application filed Feb. 5, 1889. In an electric converter the combination with primary and secondary energizing coils of a laminated core common to both and one or more conductors, each connecting two or more plates separated from one another by other plates and insulated from the latter.

484,964. Electric Search Light; L. Hills, New York, N. Y. Application filed Sept. 24, 1891. In a projector or search light, the combination of the horizontal rotatable frame, the projector pivoted thereon to swing in a vertical plane, a gear wheel or wheels carried by said frame, a segmental gear upon the bottom of the projector, engaging directly with said wheels, and an operating chain or cord passing over a wheel upon the same shaft with the gear wheel and extending down beneath the support for said rotatable frame.

484,986. Trolley Pole Catcher; M. M. Wood, Chicago, Ill. Application filed June 4, 1891. In a trolley pole catcher, the combination of a normally upward projecting trolley pole with a rope attached thereto and normally loose, a reel for such rope, and a motor to wind the reel, and a catch normally locking the reel from rotation, bat adapted to be released by tension on the rope.



No. 485,017—Electric Soldering.

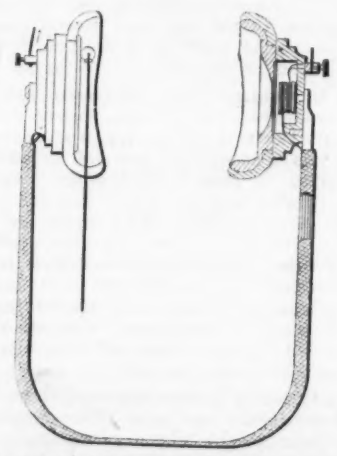
485,013. Secondary Battery; W. Main, Brooklyn, N. Y. Application filed Feb. 15, 1892. A secondary battery cell having a hydrogen electrode, consisting of a vertical support inactive in the liquid, having an affinity for but not penetrated by mercury, and a coating of zinc and mercury on the surface of the support, forming the active material.

485,017. Electric Soldering; E. E. Ries, Baltimore, Md. Application filed July 17, 1891. The method of soldering metallic articles together, which consists in fusing the solder at the point or line of union by heat radiated from an electrically heated body.

485,027. Telephone Support; G. V. Benjamin, Ithaca, N. Y. Application filed March 19, 1892. In a telephone, the combination of receivers, adapted to be applied to both ears with a horseshoe magnet having two limbs of soft iron, joined together by a piece of spring steel integral therewith.

485,028. Electrical Switch; G. Binswanger, of London, Eng. Application filed May 6, 1892. In an electric switch, the combination of one or more bars, a rocking handle, and a line pivoted to both, the rocker axis of the handle lying between its knob and its link joint, and the length of the link admitting the said joint being straightened out and closing the switch.

485,054. Regulation of Alternating Current Generators; G. Pfannkuche, Cleveland, Ohio. Application filed Nov. 30, 1887. The combination with a separate exciting dynamo and a number of alternating current dynamos having their field coils connected in series, and their armatures in multiple arc, and a main or trunk line supplied by said armatures, of two inductoriums having their coarse wire coils included in circuit with the field coils of said exciting dynamo, and their fine wire coils included one in the main or trunk line, and the other in a branch derived therefrom in multiple arc with the working devices in the said main or trunk line, and a commutator in the circuit from the last mentioned inductoriums to the field coils of the exciting dynamo.



No. 485,027—Telephone Support.

485,089. Standard Cell for Electric Batteries; H. S. Carhart, Ann Arbor, Mich. Application filed July 11, 1892. In a standard cell, the combination of a vessel, a mercury salt therein connecting with one terminal of the cell, a zinc element connecting with the other terminal, an electrolytic fluid in contact with the zinc and mercury salt, and a porous partition or diaphragm between the zinc and mercury.

485,105. Insulator for Electric Railway Conductors; C. T. Lee, Boston, Mass. Application filed March 17, 1892. An insulator comprising a case, an insulating block within said case, a connecting stem insulated from said case by said block, a collar surrounding said case and loosely secured thereto, and means for securing said collar to the insulator support, whereby the case and the insulation and insulated parts contained therein may be rotated within the collar.

485,106. Insulator; C. T. Lee, Boston, Mass. Application filed March 17, 1892. An insulator comprising an insulating block composed of a series of sheets of mica and means whereby said sheets are suitably secured together, combined with a spindle or support therefor passing partially through said block.

Copies of the specifications and drawings complete of any patent mentioned in this record—or of any other patent issued since 1886—can be had for 25 cents. Give date and number of patent desired and address The W. J. Johnston Co., Ltd., Times Building, N. Y.